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Reeder Reservoir Maintenance Operations An Element of the Rogue Valley Water Quality Management Plan

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This environmental impact statement provides information that assisted EPA and the public in making the decision to approve the Reeder Reservoir element of the Rogue Valley Council of Governments' Water Management Plan. The document identifies problems associated with the removal of accumulated debris and sediment that flows into the reservoir, specifically with slucing as a method of removal by the City of Ashland, Oregon. A major portion of the statement deals with the impacts of viable alternatives to sluicing. Details on the topography, geology, soils, climate and hydrology of the Ashland watershed and the Bear Creek Basin in southwestern Oregon are given.

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Reeder Reservoir Maintenance Operations

An Element of the Rogue Valley Water Quality Management Plan

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SPRINGFIELD, VA 22161

FINAL ENVIRONMENTAL IMPACT STATEMENT

REEDER RESERVOIR MAINTENANCE OPERATIONS

An Element of the Rogue Valley Water Quality Management Plan

Prepared by
U.S. Environmental Protection Agency
Region 10
Seattle, Washington 98101

With Technical Assistance from
Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, California 95816

Responsible Official:

Donald P. Dubois
Regional Administrator

JUL 21 1980

Date

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SUMMARY

FINAL ENVIRONMENTAL IMPACT STATEMENT

REEDER RESERVOIR MAINTENANCE OPERATIONS

An Element of the Rogue Valley
Water Quality Management Plan

Prepared by: U. S. Environmental Protection Agency (EPA)
Region X
1200 Sixth Avenue
Seattle, Washington 98101

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Description of Project

The City of Ashland, Oregon operates Reeder Reservoir to provide a domestic water supply for the city. The reservoir must be periodically cleaned to remove accumulated debris and sediment that flows into the reservoir, primarily during periods of heavy runoff. The reservoir is presently drained in the early spring of relatively wet years, and sediments are sluiced through the reservoir outlet to be carried downstream in Ashland Creek into Bear Creek, and eventually into the Rogue River. Water quality violations and degradation of fisheries habitat result. On two occasions, in 1964 and 1974, sediment inflows were so great that the city could not sluice, and instead elected to dredge sediments and discharge the slurry back to Ashland Creek below the dam. The 1974 dredging, conducted from late May to early July 1974, drew many complaints from downstream water users along Bear Creek and destroyed virtually the entire year's spawn of salmonid fishes.

As part of the Rogue Valley Council of Governments' (RVCOG) Water Quality Management Plan, the City of Ashland proposes to continue the spring sluicing of Reeder Reservoir on an as-needed basis.

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The purpose of this EIS has been to provide information to EPA and the public to assist EPA in making the decision to approve the Reeder Reservoir element of the RVCOG Water Quality Management Plan. It is also hoped that the information in this EIS will help the City of Ashland and other local decision makers in taking steps to resolve identified water quality problems in Ashland Creek and Bear Creek. The proposed EPA decision to conditionally approve this element of the plan (see Chapter 5, IDENTIFICATION OF EPA PREFERRED ALTERNATIVE) has been made following consideration of written comments on the Draft EIS released in July 1979, and after analysis of oral testimony from the public hearing in August 1979. The decision will be finalized no sooner than 30 days following release of this Final EIS.

Conclusions

Certain conclusions are evident from the analyses in this EIS. This portion of the SUMMARY provides a brief overview of major study findings and conclusions.

Prior to 1956 the City of Ashland reportedly sluiced relatively small amounts of sediment from Reeder Reservoir each year. In 1956 the U. S. Forest Service (USFS) initiated multiple use management of the Ashland Creek watershed, including construction of new roads, timber harvesting, and development of a ski area. These activities increased the volumes of sediments tributary to Reeder Reservoir by a factor of about 3 to 10 times the estimated pre-1956 levels. Reeder Reservoir traps nearly all of these sediments. When the reservoir is cleaned, an unnaturally high sediment concentration is released into Ashland Creek, with adverse effects on downstream beneficial uses, which include municipal water supply, irrigation, fisheries, recreation, and aesthetic quality. This EIS focuses on the ways in which reservoir cleaning can be accomplished while minimizing adverse impacts.

The Ashland watershed is not the only contributor of sediments in the basin. Neil Creek contributes granitic sediments, and nongranitic sediments are produced by other creeks and by return flows from agricultural lands. It is not known what proportion of total sediments in Bear Creek originate in the Ashland watershed. However, when Reeder Reservoir is cleaned it becomes the most visible contributor of sediment to Bear Creek by releasing large quantities of sediment for short periods, increasing sediment loadings in Ashland and Bear Creeks by several hundred percent.

The movement of sediments is a complex function of sediment size, stream morphology, water velocity and depth, and flow duration. Sediment will move in suspension in the water and as bedload along the bottom of the stream. The higher the flow the greater the carrying capacity of each unit volume of water. Thus, the highest flows carry the vast majority of sediments. However, actual quantification of the sediment carrying capacity of Bear Creek was considered by EPA to be beyond the scope of this EIS and has not been attempted. For this reason many of the impact assessments are based on prior observations and general relationships rather than on detailed calculations.

When sediments are introduced into the Bear Creek system, their impact on beneficial uses depends in large part on the time of year they enter relative to each beneficial use and how long they remain in the streams. The rate at which sediments are introduced relative to stream flow volume may also be a factor in severity of impact.

The sediment residence time is dependent in large part on whether sufficient high stream flows occur for a long enough period to flush the material on through to the Rogue River. The highest flows are most likely to occur in Bear Creek between the first part of December and the end of April.

Irrigators generally use water from April 15 to October 15. Salmonid fish are most dependent on the stream from December to July (most critically January through May) and recreation and aesthetic uses are most heavy in summer. Municipal water supply use by the City of Talent occurs all year. The greatest conflicts from reservoir cleaning are likely to occur with the salmonid fishes and municipal water supply with lesser conflicts with irrigation, recreation and aesthetics.

The four alternatives evaluated in this EIS are restricted as to discharge time to between November 15 and March 31 by a discharge permit issued by the Oregon Department of Environmental Quality (DEQ). Within that period, the four alternatives would discharge at different times and potentially at different rates. Thus, the focus of the EIS is on those differences as they affect beneficial uses, particularly as measured by water quality and fisheries effects, and on the loss of stored water from Reeder Reservoir during cleaning as it affects the city's water supply.

In reaching the present decision, EPA considered the following reservoir cleaning alternatives:

- Continuing the present spring draining and sluicing.
- Using a dredge to remove and discharge sediments to Ashland Creek during periods of high stream flow.
- Draining and sluicing in the late fall.
- Draining in the late fall and leaving the reservoir empty and the outlet open until early spring.

Each alternative is likely to be implemented every other year, on the average, except fall draining with the outlet open all winter, which would be implemented each year.

Spring sluicing releases the sediments to Ashland and Bear Creeks in February or March of years with above-average snow accumulations in the Ashland watershed. Higher than normal flows are also likely in Bear Creek in such years, so that the sediments may have a good chance to move on through to the Rogue River with spring runoff. However, at least some of this movement may occur during the irrigation season, and most of the movement coincides with the most critical time for the salmonid fishes.

Fall sluicing releases the sediments in November or December, giving the material a statistically greater chance to move on through to the Rogue River prior to the critical time for salmonid fishes and prior to irrigation season. However, with fall sluicing, it is not possible to deliberately select a year with relatively high stream flow. Thus, during a dry year the material sluiced in the fall could remain in Bear Creek even longer than for spring sluicing. In wet years, however, fall sluicing would have a lesser impact on the salmonid fishery if high flows occurred early enough to cleanse Bear Creek prior to the critical period.

Dredging would release the sediment during periods of higher than median stream flow, assuming practical constraints on dredging during stormy periods can be overcome. The dredge discharges are likely to stop and start, and may release sediments at any time from November 15 to March 31. The high flow periods are most likely to occur in January, February and March, relatively similar to the timing of spring sluicing. Under these conditions at least some of the sediment would be moving through Bear Creek during critical times for the salmonid fishes, and perhaps during irrigation season. In dry years, which could occur following a large sediment inflow, it may not be possible to discharge any sediment if stream flow does not reach permissible levels. Sediments from a major storm may thus have to be carried over in the reservoir until the opportunity for dredging occurs within the time and flow constraints.

Fall draining of Reeder Reservoir and leaving the sluiceway outlet open all winter would result in some incidental sluicing during draining, and would allow some sediment to pass through the reservoir within hours of its entry. During extreme floods, however, (which also produce the greatest amounts of sediment and debris) the sluiceway outlet is likely to become obstructed, retaining these high sediment volumes in the reservoirs, and requiring their later removal as in one of the other alternatives. Also the new reservoir at the Winburn site in the Ashland watershed, assumed to be part of this alternative, would also need to be drained and sluiced at a time when Reeder Reservoir was full. This sediment would in turn have to be flushed on through Reeder Reservoir, probably in the fall when Reeder Reservoir is drained pursuant to this alternative. Most sediment released under this alternative is likely to enter Bear Creek at the same time as for fall sluicing.

Regardless of when these releases occur from the various reservoir cleaning alternatives, water quality violations will occur. Turbidity and sediment loadings will increase in violation of DEQ standards, and will remain high throughout cleaning and for a month or more later in Bear Creek. Total organic nitrogen levels will increase during cleaning, returning to normal within days of completion.

Standards for stream bottom deposits are also violated by the sediments, and the adverse effects last until after the sediment has been washed on through the stream system by high flows. This may require from a month or so to more than a year, depending on the quantity of sediment and hydrologic conditions.

With higher stream flows, however, the degree to which turbidity, sediment loading and organic nitrogen levels exceed the standards is proportionately lessened. Higher flows provide greater dilution, and also result in higher natural background levels against which the violations are measured.

Thus, among the four alternatives dredging has the greatest potential for reducing the severity of water quality violations, since discharge would only be permitted during periods of high stream flow. Spring sluicing in years with a substantial snowpack would help ensure high flows later in the spring, but not necessarily during cleaning. Fall sluicing would likely occur during relatively low stream flows, with the greatest proportionate impact on pollutant levels. Fall draining with an open reservoir outlet would theoretically pass sediments during high flows, but when the outlet of Reeder Reservoir becomes blocked by flood flows and when Winburn Reservoir is sluiced, the time of release of these sediments would follow one of the other three alternatives.

High turbidity during the presence of salmonid fishes increases mortality by suffocation and abrasion, may inhibit migration of adults and fry, and deposits sediments that make stream gravels unsuitable for spawning. Abrasion and covering of stream organisms by sediments eliminates sources of food, further increasing mortality. The adverse conditions persist until sufficient stream flows flush sediments through Bear Creek and the aquatic habitat can recover.

Among the four alternatives, fall sluicing would have the least adverse impact on the salmonid fishery and aquatic habitat during years when storms occur early in the winter and flush sediments through Bear Creek prior to January. Hydrologic records indicate this to be a relatively infrequent occurrence, however, and in any event it is not predictable. Sediments sluiced in the fall are more likely to remain in Bear Creek through much of the critical periods of the salmonid species in most years.

Dredging is likely to discharge during the critical period for the salmonid fish, although since discharge only occurs during high stream flow the sediment may have a better opportunity to pass through the system sooner. Also, a major sediment inflow to Reeder Reservoir might be released over several subsequent years, rather than all at once, as with other alternatives. Since quantification of sediment movement is beyond the scope of this EIS, the degree to which these differences would benefit or adversely affect the fishery is unknown.

Spring sluicing would release the sediments during the most critical period for the fish. While higher than normal spring runoff would occur, the degree to which this might lessen the adverse impacts on the fishery is unknown.

Fall draining with the reservoir outlet open all winter would have a more frequent (yearly) discharge, with less sediment volume each year. However, the cleaning of sediments from major floods and from Winburn Reservoir would impact the fisheries as described for one of the other alternatives, depending on when and how it is removed from Reeder Reservoir.

The impacts of the four alternatives on water availability for the City of Ashland vary significantly. Spring draining and sluicing with an above-average snowpack in the watershed virtually assures that Reeder Reservoir will refill from snowmelt and provide the necessary stored water for the summer months. Dredging does not require draining, and would use only a small proportion of stored water to flush dredged sediments down Ashland Creek into Bear Creek. Fall draining, however, requires Ashland to assume the risk that about 20 percent of the time rainfall and snowfall will be insufficient to refill Reeder Reservoir, posing a substantial probability of water shortages and water rationing in the following summer. Fall draining with the outlet open all winter assumes that a new water supply reservoir would exist to prevent shortages from occurring.

Thus, fall draining and sluicing has potential substantial adverse impacts on water availability for the City of Ashland, while the other three alternatives would have no such adverse effects.

Irrigators may be affected adversely by sediments from Bear Creek silting up diversion structures, settling out in irrigation canals and clogging pumps. This is less likely when greater amounts of sediments have been flushed on through Bear Creek prior to April 15.

The City of Talent operates a water supply intake in Bear Creek that might have to suspend operation during cleaning of Reeder Reservoir due to high nitrogen levels, and due to sediments clogging the intakes.

Many of the adverse impacts identified for cleaning of Reeder Reservoir cannot be fully mitigated by any of the viable alternatives. Removal of the sediments from the creek system would largely mitigate nearly all of the impacts, although this has not been considered a viable alternative by the City of Ashland.

From a practical standpoint, spring draining and sluicing is an established practice previously selected by the City of Ashland for its practicality. It is also the least costly alternative. Dredging has been implemented twice previously, although at higher cost than sluicing.

Operation of a dredge in periods of high stream flow may mean working in wind, waves, rain or snow in the middle of Reeder Reservoir, a hazardous situation. Freezing of the reservoir surface may damage the dredge if it is not removed. Also, the city may have difficulty recruiting qualified dredge operators for relatively few days of work each winter, and with no work is some years. Finally, the city believes dredging to be only partly effective based on prior experience, necessitating draining and sluicing every 3 to 4 years.

Fall sluicing may run the risk of insufficient flows to sluice the reservoir, although it may be possible to sluice at lower flows at slower rates. Otherwise practical, except for its adverse effects on water supply, it would be slightly more costly than spring draining and sluicing.

Fall draining with the outlet open all winter, and with Winburn Reservoir constructed, would also be practical. It is also the most expensive due to the cost of the dam. However, within the next decade the City of Ashland will probably need to develop a new water supply or take steps to limit total water consumption. Thus, the dam may be required just to meet the city's growth and may eventually exist regardless of the reservoir cleaning alternative selected. This would probably make fall sluicing a more acceptable alternative by mitigating adverse impacts on Ashland's water supply.

From an economic view, total annual costs of alternatives have been estimated in 1977 dollars. The following table summarizes these costs:

Alternatives	Average Annual Cost
1. Spring sluicing	$23,900-$26,300
2. Dredge during high stream flow	$50,200
3. Fall sluicing	$45,400-$47,800
4. Fall draining, open through winter	$209,000

The costs include labor, equipment rental or purchase, estimated fishery losses, water revenues lost, and dam and pipeline construction costs, as appropriate.

Based on the analysis in this EIS, as well as written and verbal public comments, EPA is proposing to conditionally approve the Reeder Reservoir element of the RVCOG Plan, with the recommendation that either dredging or spring draining and sluicing be implemented, as agreed upon by RVCOG and the City of Ashland.

Regardless of which of the foregoing alternatives is implemented, the findings of this study support the recommendations of Montgomery Engineers (1977) that the City of Ashland add new water supply intakes at the reservoir, and enlarge the dam's sluiceway outlet and improve the trash racks. These modifications would improve the protection of the city's water supply from disruption by major sediment inflows and allow greater flexibility in cleaning accumulated sediment during high stream flow and after floods in the watershed. The cost of modifying the intake and sluiceway outlet, including a feasibility study, is estimated at about $215,000 (1977 dollars). If the recommended modifications had been in place in 1974, it is likely that the impacts of subsequent cleaning operations could have been reduced. EPA approval is conditioned on the city's and RVCOG's agreement to implement these structural improvements.

Distribution of the Final EIS

FEDERAL AGENCIES

U.S. Department of Agriculture
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    Rogue River National Forest
    Soil Conservation Service
    Agricultural Stabilization and Conservation Service

U.S. Department of Commerce
    National Marine Fisheries Service

U.S. Department of Defense
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City of Central Point

Jackson County

Rogue Valley Council of Governments

Medford Irrigation District

Rogue Valley Irrigation District

Talent Irrigation District

Medford Public Works

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Availability of Final EIS

It is anticipated that notice of availability of this Final EIS will be published in the *Federal Register* in August 1980. The above listed agencies, organizations, and individuals are invited to comment on the Final EIS.

Chapter 1

INTRODUCTION

The National Environmental Policy Act of 1969 (NEPA) requires all federal agencies which propose actions that would significantly affect the quality of the human environment to prepare an Environmental Impact Statement (EIS) on these actions. The EIS is intended to be a "full disclosure" of impacts which would result from a project or action, and must follow specific guidelines established by the Council on Environmental Quality (CEQ). It is not the intent of NEPA that alternatives be evaluated and a plan selected or rejected on the basis of environmental considerations alone, but rather that the planning process consider all significant environmental, social, and monetary costs.

The RVCOG prepared and submitted to EPA an areawide waste treatment management plan for the greater Bear Creek Basin, pursuant to Section 208 of the Clean Water Act. EPA approved the plan, but has deferred action on additional 208 elements, including the element that embodies the cleaning of Reeder Reservoir, which is operated by the City of Ashland for water supply purposes. Past cleaning operations have resulted in potentially significant impacts on water quality, fisheries and downstream irrigators. As a result, EPA has determined that an EIS must be prepared on the cleaning of Reeder Reservoir prior to approving that element of the 208 plan.

The purpose of this EIS has been to provide information to EPA and the public to assist EPA in making the decision to approve the Reeder Reservoir element of the RVCOG Water Quality Management Plan. It is also hoped that the information in this EIS will help the City of Ashland and other local decision makers in taking steps to resolve identified water quality problems in Ashland Creek and Bear Creek. The proposed EPA decision to conditionally approve this element of the plan (see Chapter 5, IDENTIFICATION OF EPA PREFERRED ALTERNATIVE) has been made following consideration of written comments on the Draft EIS released in July 1979, and after analysis of oral testimony from the public hearing in August 1979. The decision will be finalized no sooner than 30 days following release of this Final EIS.

This EIS evaluates four major alternative cleaning methods for Reeder Reservoir, and explores the impacts and issues related to each. EPA is recommending either of two of these alternatives, dredging or spring draining and sluicing, to the Rogue Valley Council of Governments for incorporation into the Water Quality Management Plan, along with certain conditions and recommendations.

Legal, Regulatory and Institutional Constraints

There are a number of legal, regulatory and institutional constraints which directly affect the operation and cleaning of Reeder Reservoir. These include the National Environmental Policy Act of 1969 (NEPA), Clean Water Act of 1977, Oregon State Department of Environmental Quality Water Standards for the Rogue River Basin, and a DEQ waste disposal permit issued to the City of Ashland in September 1978. Other constraints include Congressional and Presidential actions, and an agreement signed between the City of Ashland and the USFS in 1929.

National Environmental Policy Act

According to Section 102(2)(c) of NEPA all proposed federal projects or actions significantly affecting the quality of the human environment must include a detailed statement on the following:

1. The environmental impact of the proposed action.
2. Any adverse environmental effects which cannot be avoided should the proposal be implemented.
3. Alternatives to the proposed action.
4. The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.
5. Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Clean Water Act of 1977

The EPA is charged with administering the Clean Water Act of 1977, formerly known as the Federal Water Pollution Control Act of 1956 (FWPCA). Under Section 208 of the act, EPA is required to prepare and enforce minimum water quality standards for the nation, and is also responsible for approving plans and programs to control "nonpoint" source pollution. Under Section 208 the state must identify regions with "substantial water quality control problems" and authorize a single organization to operate "a continuing areawide waste treatment management planning process". The RVCOG has been designated to conduct control studies within the Rogue River/ Bear Creek Basin to provide the background for water quality management planning. Their 208 planning program includes municipal waste treatment, agricultural nonpoint sources, urban storm runoff and silvicultural nonpoint sources. The Water Quality Management Planning Program sponsored by the RVCOG has been developed to enable the residents of Rogue Valley to determine how they will meet the 1983 federal standards of "fishable and swimmable" waters in the area's streams. EPA reviews the water quality management plan elements prepared pursuant to Section 208 of the act, and may approve, conditionally approve, or disapprove them. This EIS is intended to provide information leading to an EPA decision on the Reeder Reservoir maintenance element of the RVCOG plan.

DEQ Water Quality Standards

The Oregon State Department of Environmental Quality is responsible for establishing and enforcing basinwide water quality standards for the Rogue River Basin (Appendix A). According to the standards, water quality in Bear Creek shall be managed to protect the beneficial uses of the stream waters, including domestic and industrial water supply, irrigation, anadromous salmonid passage, spawning and rearing, resident fish and aquatic life, and water contact recreation and aesthetic quality.

DEQ Waste Discharge Permit

The Oregon Department of Environmental Quality issued a waste discharge permit to the City of Ashland in September 1978 (Appendix B). The permit restricts the discharge of accumulated reservoir sediment from Reeder Reservoir to Ashland Creek for the period of November 15 to March 31. The permit requires the City of Ashland to monitor the reservoir cleaning operation and collect data on a daily basis during the operation on the quality of sediment discharged, settleable solids, suspended solids and turbidity.

The City of Ashland is also required to cooperate with the USFS to develop an Ashland Creek watershed management and monitoring plan as outlined in the city/USFS Memorandum of Understanding revised on October 7, 1977.

Compliance conditions of the permit also include the requirement that the City of Ashland, by December 31, 1978, "prioritize and establish implementation time schedules for recommendations involving the operation of Reeder Reservoir included in the 'City of Ashland, Oregon, Water Resources Management Plan and Facility Study', October 20, 1977". It is expected that this requirement will be met in the fall of 1979, following completion of this EIS.

Presidential and Congressional Actions and Agreement Between USFS and the City of Ashland

The Ashland watershed has served as the water supply for the City of Ashland since the early 1880s. In 1893, 18,500 acres of the federally-owned watershed were proclaimed a preserve by President Grover Cleveland to protect the city's water supply. In 1906 and 1907 President Theodore Roosevelt added substantial acreage to the "Ashland Forest Preserve" by proclamation. Congress added further land in 1920 as part of PL 137.

Protection of the watershed now seemed assured. By the early 1920s the City of Ashland was realizing that the growing water needs of the city would exceed the availability of stream flow in the East and West Forks of Ashland Creek at low flow periods. Studies of storage on Ashland Creek, diversion from Neal Creek (now Neil Creek) and use of Talent Irrigation District (TID) water were undertaken. In 1928, Hosler Dam was constructed below the confluence of the East and West Forks of Ashland Creek, forming Reeder Reservoir with a capacity of 28,000,000 gallons.

In 1929 the City of Ashland and the Secretary of Agriculture entered into an agreement to protect and conserve the city's water supply (Appendix C). The agreement provides for: (1) input from the city regarding safeguarding of the city's water supply prior to timber cutting and removal, (2) consideration for preserving the volume and purity of the city's water supply, (3) limitation of livestock grazing in the watershed, (4) improvement of the watershed forest through methods of silviculture and forest management, and (5) protection of the watershed in connection with adjoining national forest lands. Both parties reserve the right to terminate the agreement at any time, provided all obligations under the agreement up to the date of termination have been met. The agreement is still in force.

In 1936 PL 642 was passed which provided "that when the Secretary of Agriculture finds that merchantable timber may be cut without detriment to the purity or depletion of the water supply..." that it would be harvested. No action to harvest timber was taken until 1955, when the watershed was placed under multiple use management. From 1956 to 1963, 40 to 45 miles of logging roads were constructed, and between 1958 and 1965 approximately 1,000 acres were logged. In 1960, 180 acres were developed as the Mount Ashland Ski Resort, which opened in 1964. In total about 10 percent of the watershed was disturbed by these activities.

Unfortunately, the granitic soils in the watershed are very susceptible to erosion, as evaluated by a U. S. Forest Service in-house study in early 1956, prepared by Mr. John Arnold. Changes in amounts of eroded materials deposited in Reeder Reservoir following inauguration of multiple use management confirm this analysis.

Before 1955 the annual cleaning of Reeder Reservoir involved the flushing of less than 4,000 cubic yards of granitic sediments into Ashland Creek; however, starting in the early 1960s greater and greater volumes of sediment were removed, especially following the major storm events of 1964 and 1974. These two storms produced approximately 60,000 and 122,000 cubic yards of sediment, respectively (Montgomery, 1977; ODFW, 1974).

Chapter 2

REGIONAL ENVIRONMENT

Introduction

The Ashland watershed is located in Jackson County in southwestern Oregon, about 15 miles southeast of the City of Medford, and about 10 miles north of the Oregon-California border (Figure 2-1). The two main streams in the Ashland watershed are the East and West Forks of Ashland Creek, which meet at Reeder Reservoir. Below Hosler Dam, which impounds the reservoir, Ashland Creek flows north for about 4 miles through the City of Ashland to the confluence with Bear Creek (Figure 2-2).

The watershed area is about 14,400 acres (22½ square miles) in size, of which about 12,500 acres (19½ square miles) is tributary to Reeder Reservoir (Figures 2-3 and 2-4).

The watershed is steeply sloped and heavily forested, ranging in elevation from 2,800 to 7,500 feet above sea level. The watershed is located entirely within the Ashland stock granitic batholith which is more than 18 miles long from north to south and 10 miles wide (Wells, 1956). The soils produced from the granitic bedrock are coarse in texture, and are relatively thin, averaging 6 inches to 1 foot in depth, and are very susceptible to weathering and slope erosion.

The climate of the area is characterized by mild, wet winters and hot, dry summers, with most rainfall occurring between October and April, averaging 20 inches per year in the Bear Creek Valley and 25 to 40 inches per year in the higher elevations. Ashland Creek is a tributary to Bear Creek which flows into the Rogue River, and into the Pacific Ocean near Gold Beach.

Bear Creek Basin

Topography

The Bear Creek Valley is located on the western slope of the Cascade Divide, which forms its eastern border. The western rim of the valley is formed by a ridge of the Klamath

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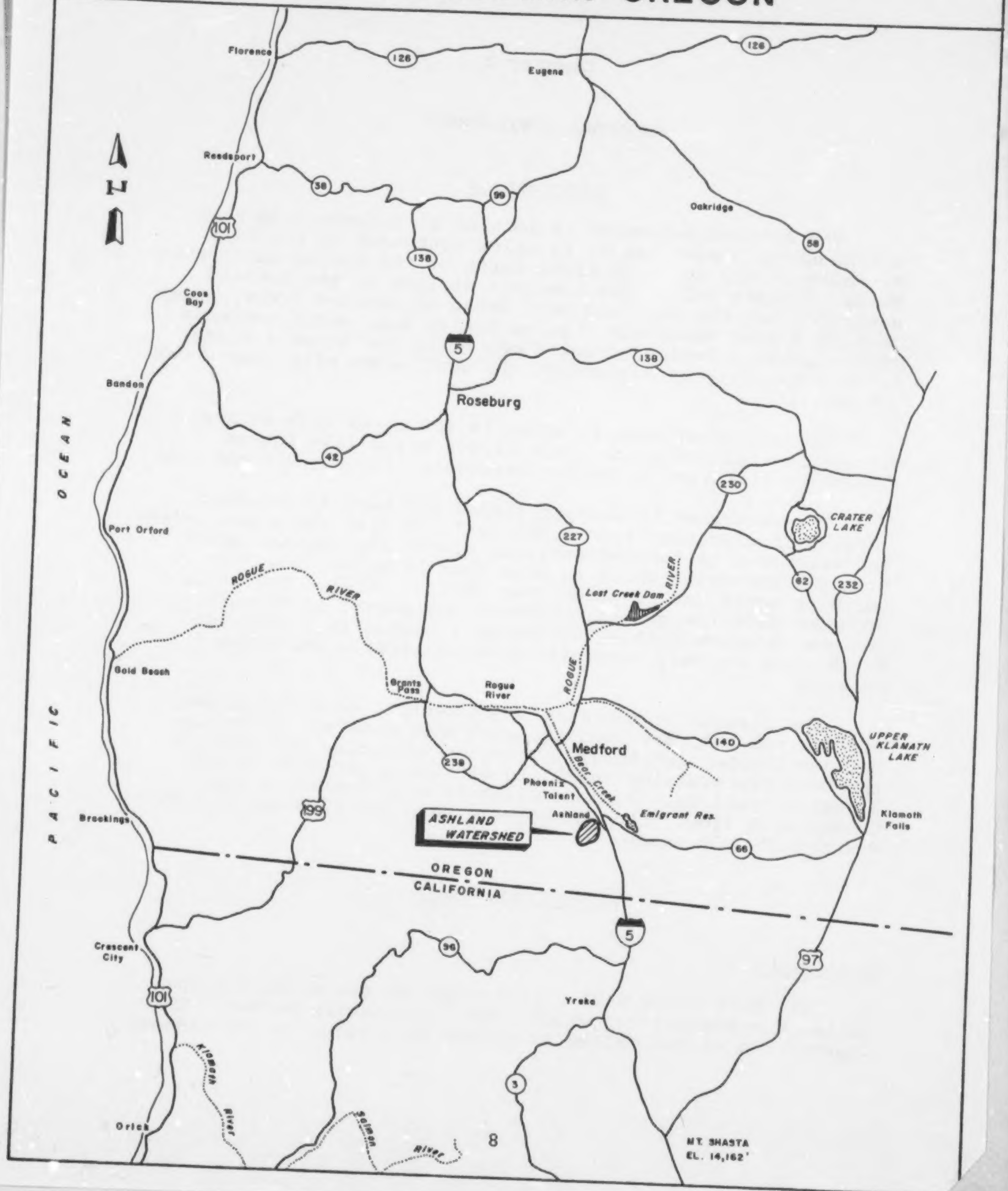
FIGURE 2-1

SOUTHWESTERN OREGON


N
Florence
126
Eugene
126
Reedsport
38
99
Oakridge
58
101
138
Coos Bay
5
138
Bandon
Roseburg
42
230
PACIFIC OCEAN
Port Orford
227
CRATER LAKE
ROGUE RIVER
Lost Creek Dam
RIVER
62
232
Gold Beach
Grants Pass
Rogue River
ROGUE
140
UPPER KLAMATH LAKE
Medford
238
Bear Creek
Phoenix
Talent
Ashland
Emigrant Res.
199
Brookings
ASHLAND WATERSHED
Klamath Falls
66
OREGON
CALIFORNIA
5
Crescent City
96
97
101
Yreka
Klamath River
3
Salmon River
Orick
MT. SHASTA EL. 14,162'

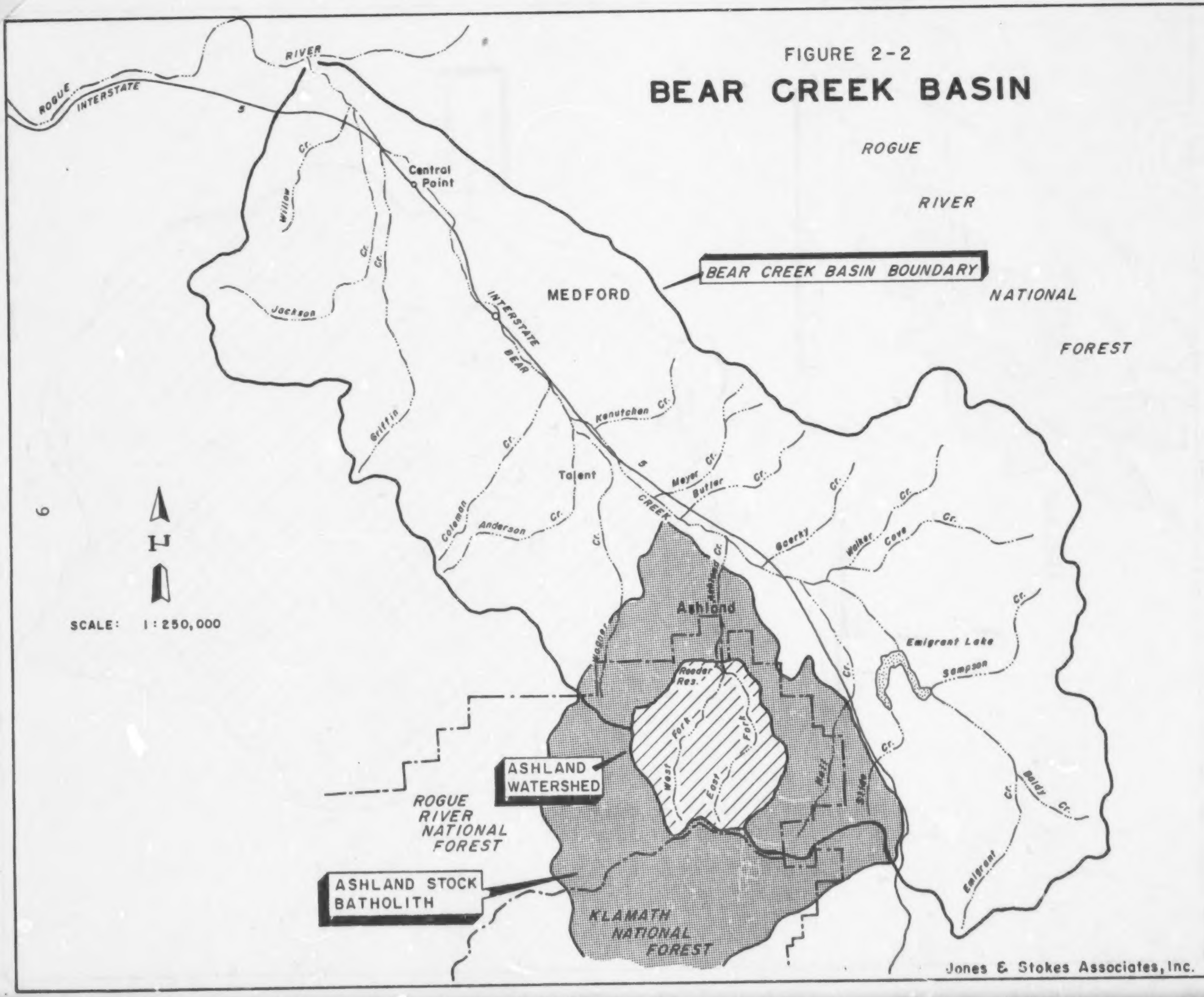


FIGURE 2-2

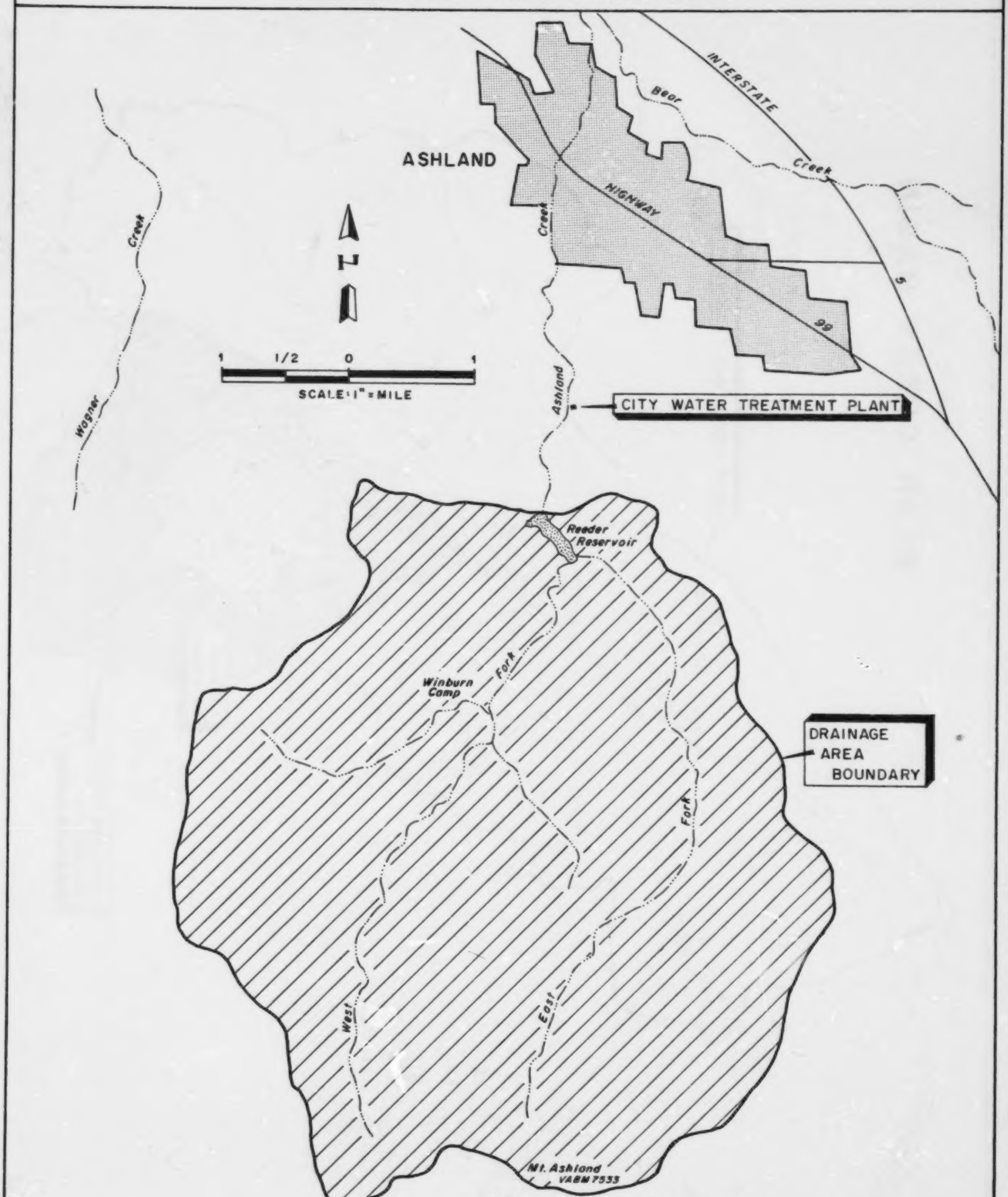
BEAR CREEK BASIN

ROGUE
RIVER
NATIONAL
FOREST
BEAR CREEK BASIN BOUNDARY
ROGUE
RIVER
INTERSTATE
5
Willow
Cr.
Jackson
Cr.
Central Point
MEDFORD
INTERSTATE
BEAR
Griffin
Cr.
Kenutchen Cr.
5
Talent
Coleman
Anderson
Cr.
Cr.
Meyer Cr.
Butler Cr.
CREEK
Cr.
Cr.
Cr.
Gaerky
Walker
Cove
Cr.
Ashland
Ashland Cr.
Wagner
Reeder Res.
West Fork
East Fork
Neil
Cr.
Cr.
Emigrant Lake
Sampson
Cr.
Cr.
Baldy
Cr.
Emigrant
ASHLAND WATERSHED
ROGUE RIVER NATIONAL FOREST
ASHLAND STOCK BATHOLITH
KLAMATH NATIONAL FOREST
SCALE: 1:250,000

Jones & Stokes Associates, Inc.

FIGURE 2-3

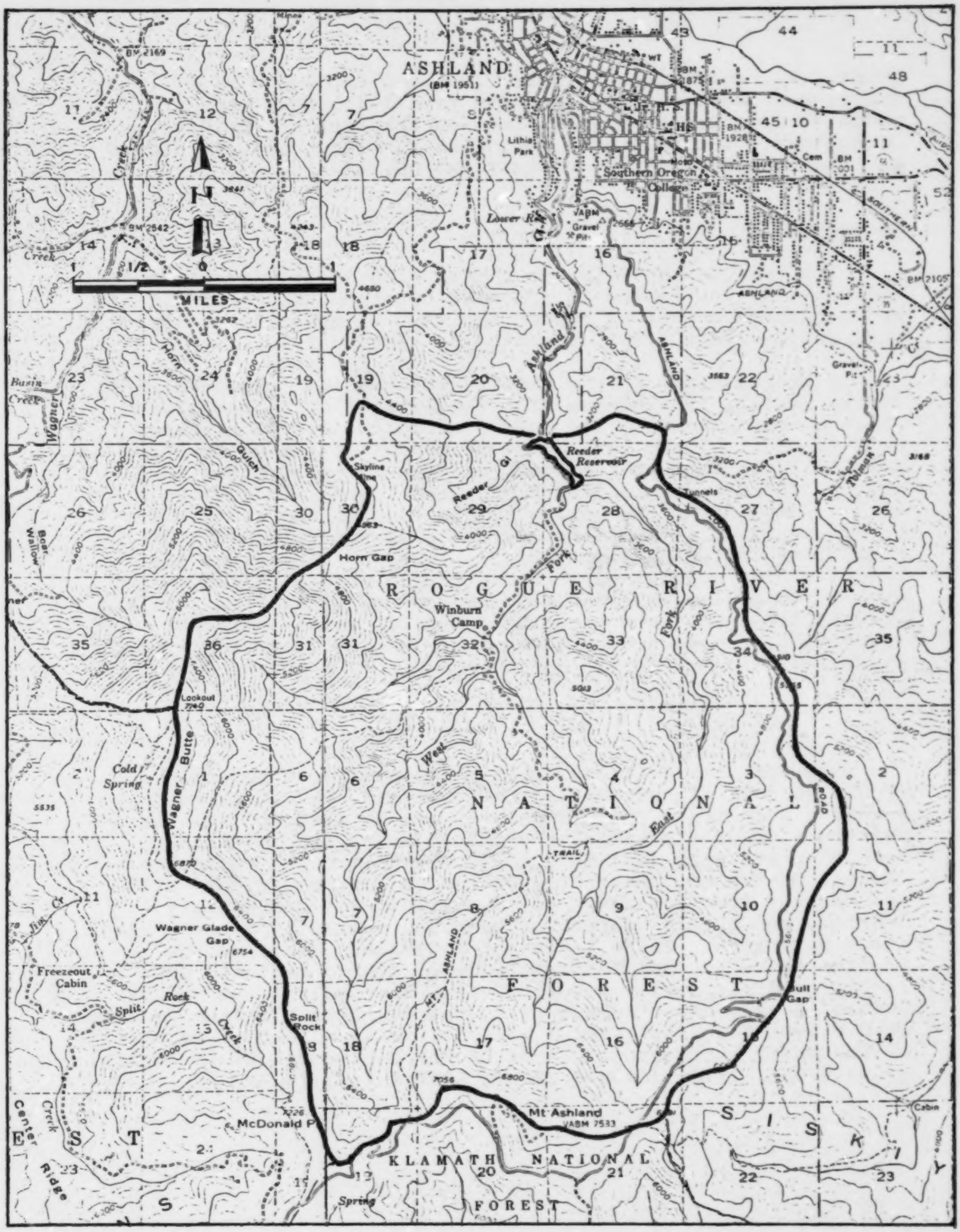
ASHLAND WATERSHED


INTERSTATE
5
Bear
Creek
ASHLAND
HIGHWAY
99
Creek
Ashland
Creek
Wagner
N
1
1/2
0
1
SCALE: 1" = MILE
CITY WATER TREATMENT PLANT
Reeder
Reservoir
Winburn
Camp
Fork
Fork
West
East
DRAINAGE
AREA
BOUNDARY
Mt. Ashland
VABM 7533

Jones & Stokes Associates, Inc.

FIGURE 2-4

ASHLAND WATERSHED TOPOGRAPHY


ASHLAND
Lithia Park
Southern Oregon College
Lower Res
Reeder Reservoir
Skyline Mine
Horn Gap
ROGUE RIVER NATIONAL FOREST
Winburn Camp
Lookout 7240
Wagner Butte
Cold Spring
Wagner Glade Gap
Freezeout Cabin
Split Rock
Split Rock Creek
McDonald P
Mt Ashland
VABM 7533
KLAMATH NATIONAL FOREST
Bull Gap
Tunnels
East Fork
West Fork
Ashland Cr
Horn Gulch
Wagner Creek
Center Ridge
MILES
1 1/2 0 1

SOURCE: USGS ASHLAND & TALENT 15' QUADRANGLE MAPS

Mountains, separating the Bear Creek and Applegate River drainages. Valley elevations run from 1,140 feet near the mouth of Bear Creek to 2,000 feet in the area of the City of Ashland. The valley is narrow at its upper end and widens as it approaches the Rogue River (RVCOG, 1976).

Geology

The Bear Creek Valley is eroded with shale and sandstone bedrock. It is flanked on the west by steep ridges of granitic and metamorphic bedrock and on the east by moderately sloping sedimentary and volcanic terrain (Schlicker, 1970).

A geologic map of the Medford Quadrangle, Oregon-California (Wells, 1956) shows that the Ashland stock batholith, which is approximately 110 square miles in area (Schlicker, et al., 1970), forms the southwest border of the valley from near Siskiyou Pass at its upper end to a point 3 miles northwest of the City of Ashland along Bear Creek. From there to the Rogue River the valley is bordered on the southwest by a mixture of sedimentary, metamorphic and volcanic rock formations including sandstones, shales, conglomerates and basalts. The northeastern border of the valley is formed by a 3- to 5-mile wide band of sedimentary rocks from Siskiyou Pass to the Agate Desert north of Medford which includes sandstones, shales and conglomerates (Wells, 1956; Schlicker, et al., 1970).

Soils

The soils of Bear Creek Valley are quite diverse because of the variety of sedimentary, metamorphic, volcanic and granitic rock types from which they are formed. On the northeastern side of the valley the upland soils are moderately deep clay and clay pans derived from volcanic and sedimentary rocks. On the southwest side of the valley the upland soils are derived from a mixture of metamorphic and sedimentary bedrock, and quartz diorite or granite, mainly from the Ashland stock batholith. These soils are moderately deep, medium to fine textured, and moderately deep, coarse textured and highly erodible soils, respectively. The soil of the valley bottom is very deep, medium to coarse textured alluvium developed over gravel deposits. These alluvial soils make up a majority of the prime agricultural lands of the Bear Creek Basin (Wells, 1956; RVCOG, 1976; Jones & Stokes Associates, 1977).

Climate

The Bear Creek Basin has a moderate climate and marked seasonal differences. Damp, cloudy and cold weather is common from November through March due to the influence of marine air, with average minimum temperatures dropping just below freezing in December and January. During the late spring, summer and early fall months prevailing continental winds aloft produce warm, dry and sunny weather (RVCOG, 1976).

The annual average temperature recorded at the Medford Experiment station is 52.4°F. Monthly averages range from 37°F to 71°F (U. S. Department of Commerce, 1975).

The coastal mountains to the west and south act as a rain shadow for the valley and result in relatively light annual precipitation in the valley floor, falling mostly during the winter months. The average annual rainfall for the Medford Experiment Station is 21.3 inches per year. The higher mountain elevations surrounding the valley may receive as much as 70 inches per year (U. S. Department of Commerce, 1975). Snowfall is limited mostly to the surrounding mountains during the winter, providing runoff during the spring and early summer months. The average length of the growing season is 170 days, from April 30 to October 17.

Hydrology

Under natural conditions the seasonal flow pattern in Bear Creek and its tributaries reflects precipitation patterns and snowmelt patterns for the area with the highest flows usually occurring during the late winter and spring with the streams becoming intermittent or dry at lower elevations during the late summer and early fall (RVCOG, 1976). Intensive irrigation has modified stream flow in the basin since at least the early 1900s. Completion of Emigrant Dam in 1924 further modifed the hydrology. Summer releases from Emigrant Dam, combined with imports from other basins, now provide year-long flows in Bear Creek, which previously was nearly dry toward the end of most summers.

Both seasonal stream flow patterns and the total volume of flow through Bear Creek and many of its tributaries have changed significantly since the USGS began gauging flows of Bear Creek at Medford in 1917. As shown in Table 2-1. the average yearly flow in Bear Creek at Medford has nearly doubled since the 1920s. The greatest percent increase and most consistent increase in mean monthly flows has occurred

Table 2-1

COMPARISON OF MEAN MONTHLY FLOWS IN CFS ON BEAR CREEK AT MEDFORD (USGS Gauge 14357500)

Water Years						Months							
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Mean Annual
1916, 1921-1924[1]	9.85	28.5	71.1	112	220	173	152	125	54.8	10.4	2.39	3.31	80.2
1927-1940	16.2	27.6	52.4	52.2	153	173	167	108	40.5	8.89	9.47	11.6	68.3
1941-1950	21.3	47.8	119	219	215	159	171	141	92.3	19.3	15.8	13.5	103
1951-1960	46.5	70.5	215	333	410	299	201	146	91.9	25.7	20.9	27.7	157
1961-1970	56.5	75.9	273	311	183	156	216	162	92.3	55.1	57.5	52.5	141
1971-1977	44.3	90.3	147	325	175	331	289	186	101	58.2	68.5	76.3	158
1916, 1921-1977	32.4	57.1	146	216	228	207	195	139	75	27.6	27.4	29.3	115
% change between 1916, 1921-1924 and 1971-1977	+350	+220	+110	+190	-20	+92	+90	+49	+84	+460	+2800	+2200	+97

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[1] Prior to construction of Emigrant Reservoir.

during the dry season, from July through October in response to water management practices to meet irrigation demands which have developed within the basin. The supplemental irrigation flows are provided by releases of stored water from Emigrant Reservoir, and as much as 80,000 acre-feet of water transferred each year into the Bear Creek Basin from Fourmile Lake, Howard Prairie Lake, and Hyatt Reservoir within the Klamath Basin, and additional water from McDonald Creek in the Little Applegate Drainage Basin (RVCOG, 1976).

The apparent increases in mean monthly flows during the winter months may reflect increased runoff within the basin due to land use changes including urbanization, road building, stream channelization, and extensive agricultural development. Reduced infiltration, more rapid runoff response, and reduced evapotranspiration may all result from land use changes. Undoubtedly, some of the differences between the various periods also reflect normal hydrologic variations. For instance, mean February flows exhibit a wide variance during the decades for which data are presented. However, the trend toward greater total streamflow at Medford, particularly during the summer months, is obvious.

A similar trend in flood peaks also seems to have developed. Emigrant Reservoir provides some attenuation of flood flows, even though flood control is not a purpose of the dam. However, these flood attenuation properties are not evidenced when reviewing the occurrence of peak floods in Bear Creek. Based on 62 years of record (1916 through 1977), three-quarters of the greatest observed peaks have occurred in the most recent 31 years of record. This indicates that increased runoff due to land use changes has probably raised the flood hazard on Bear Creek.

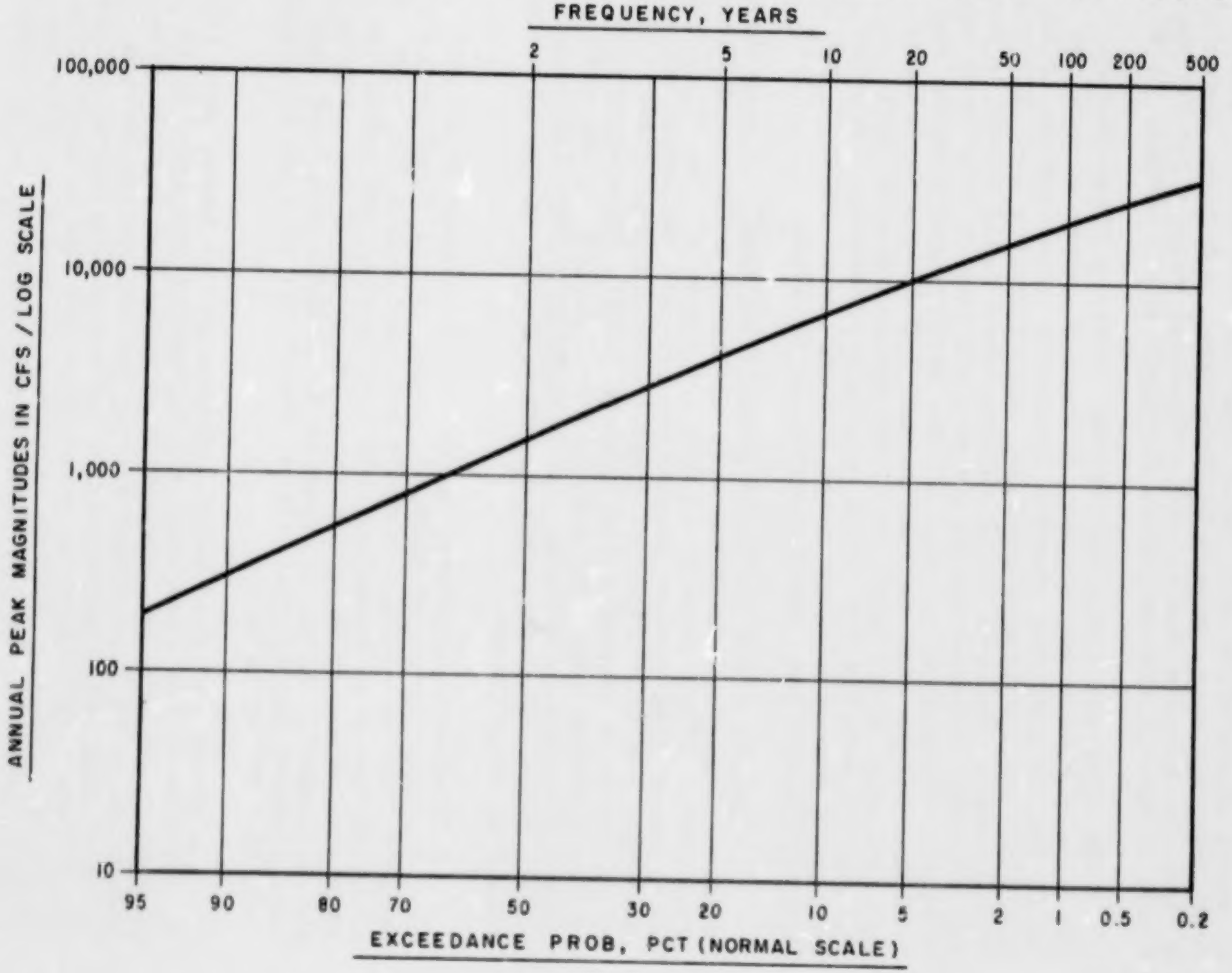
A frequency-discharge curve was developed from USGS data for Bear Creek at Medford, using annual flood peaks between 1916 and 1977. Records were available for each year, although the data cover periods both before and after the 1924 completion of Emigrant Lake, which regulates part of the watershed. Also, irrigation diversions and land uses have changed during the period, resulting in a curve (Figure 2-5) of limited utility.

Land use and flow modifications in the basin seem likely to continue. For instance, the Bureau of Reclamation is currently conducting a feasibility study for further flow augmentation in Bear Creek during the irrigation season. At this time, flow augmentation is being considered primarily for potential benefits to recreation and the salmonid fishery, including problems of fish passage over the diversion dams in Bear Creek during low flow periods (Walker, pers. comm.).

FIGURE 2-5

FREQUENCY - DISCHARGE ANALYSIS

BEAR CREEK AT MEDFORD, OREGON 1916-77 USGS GAGE NO. 14357500



SOURCE: USGS, 1978

NOTE: CURVE REPRESENTS COMPOSITE OF VARYING DEGREES OF REGULATION.

Bear Creek has 16 tributary streams, 8 draining from each side of the valley (Figure 2-2). On the southwest side of the valley between Talent and the Rogue River, Bear Creek receives Wagner, Anderson, Coleman, Griffin, Jackson and Willow Creeks, all of which drain from metamorphic or sedimentary bedrock with the exception of Wagner and Willow Creeks. The upper reaches of Wagner Creek drain about 4 square miles of the northwestern portion of the Ashland stock granitic batholith, and the headwaters of Willow Creek drain about 2 square miles of a granodiorite bedrock area just west of Central Point at the lower end of the valley. Ashland Creek drains about 240 square miles of the north-central portion of the granitic batholith (City of Ashland, 1974), and Neil Creek and its tributaries (Tolman and Clayton Creeks) drain approximately 15 square miles of the northeastern part of the batholith (Wells, 1956; Oregon State Forestry Department, 1967).

On the northeast side of the valley from its upper reaches to the Medford area, Bear Creek receives Emigrant, Walker, Gaerky, Butler, Meyer, Kenutchen, Payne and Larsen Creeks, all of which drain sedimentary and volcanic bedrock areas (Wells, 1956; Oregon State Forestry Department, 1967).

Neil, Emigrant, Ashland and Wagner Creeks, plus Emigrant Reservoir and many smaller streams are used to supply irrigation water for the Bear Creek Basin, and this is supplemented by water supplied from outside the basin by way of a system of transbasin canals, tunnels and natural drainage ways. The Talent, Medford and Rogue River Valley Irrigation Districts operate interconnected irrigation canal systems which transport water primarily by gravity flow. Within and between districts many small streams and canals, and Bear Creek itself, are used to distribute the irrigation waters. Many small irrigation diversions are made from tributaries of Bear Creek, and three major diversions are made from Bear Creek to supply the Talent, Phoenix and Hopkins Canals (LaRiviere, 1977).

Water Quality

Water quality in Bear Creek is generally good. Persistent turbidity, the presence of nutrients, and occasional coliform, dissolved oxygen and temperature increases are the major problems. The following discussion of water quality in the Bear Creek Basin is based primarily on information provided in The Water Quality Of Bear Creek and the Middle Rogue River Basins, by John LaRiviere, 1977.

Suspended Sediment and Turbidity. Large concentrations of suspended sediments in streams may adversely affect the use of water for beneficial purposes such as domestic, industrial and agricultural supply, and can be abrasive to organisms inhabiting the stream (LaRiviere, 1977). High turbidity levels associated with low levels of suspended sediment may also suffocate fish and other aquatic life, and exclude sunlight, thereby restricting the growth of both benthic and planktonic algae, which are important to the food chain (USGS, 1971).

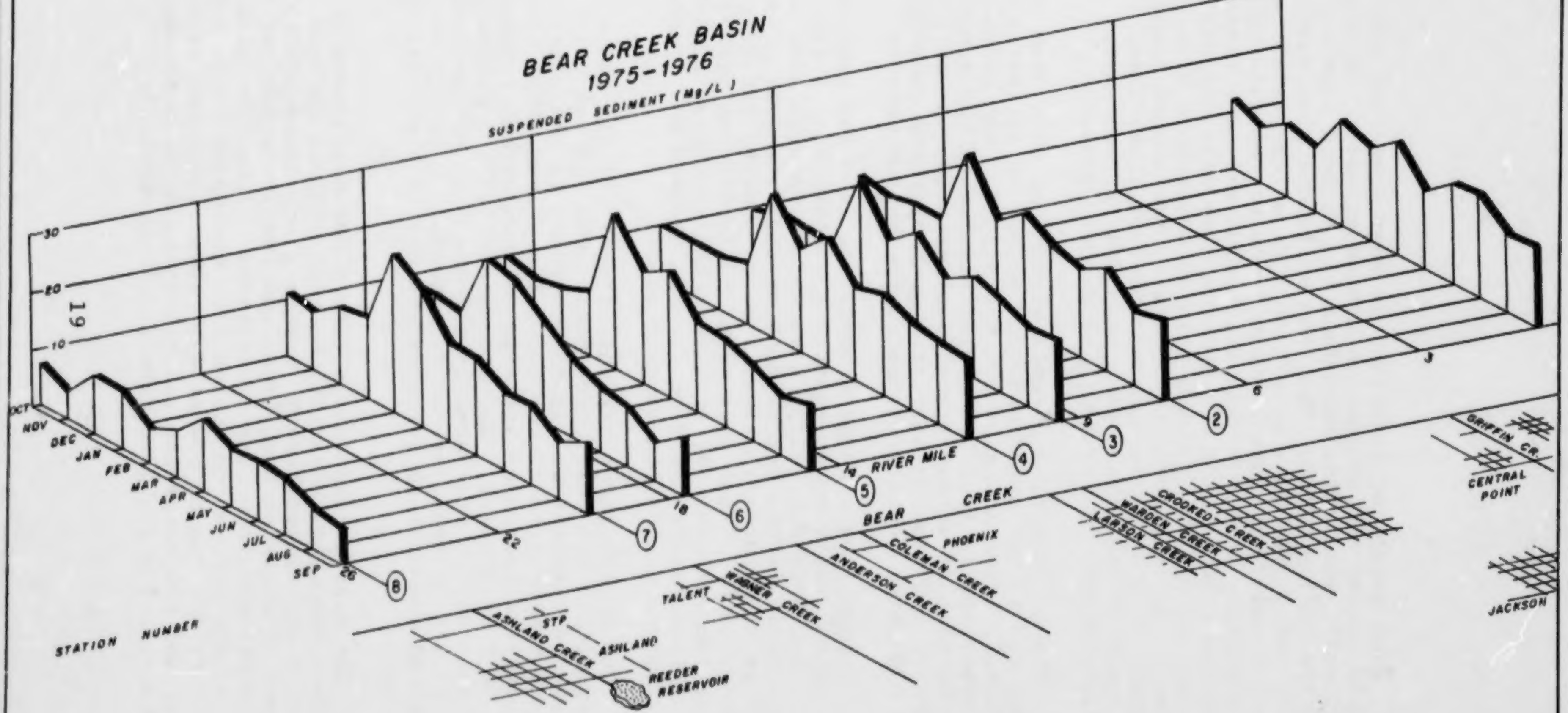
DEQ has adopted standards limiting turbidity and bottom sludge or sediment deposits in the Bear Creek Basin. There is no specific standard for suspended sediment. The DEQ water quality standard for turbidity is a maximum increase of 10 percent over natural background levels, "... except for certain specifically limited duration activities which may be specifically authorized by DEQ under such conditions as it may prescribe and which are necessary to accommodate essential dredging, construction, or other legitimate uses or activities where turbidities in excess of this standard are unavoidable." The DEQ water quality standard for bottom deposits stipulates that the formation of any organic or inorganic deposits on the stream bottom which are harmful to fish or other aquatic life, or are injurious to public health, recreation or industry shall not be allowed.

Suspended sediment is a weight per volume measurement of the matter suspended in the water column which may consist of organic or inorganic materials including soil particles, silt, sand or aquatic organisms. Turbidity is a measure of the cloudiness of water, or the extent to which light passing through water is reduced due to suspended materials (APHA, 1975). High turbidity levels are usually associated with high concentrations of suspended sediments, although when colloidal suspensions of fine clay particles produce high turbidity levels, corresponding suspended sediment concentrations may be low (LaRiviere, 1977).

Suspended sediment and turbidity levels within the Bear Creek Basin vary both seasonally and from stream to stream and are highest during winter peak flow periods (Figure 2-6). High levels of suspended sediments and turbidity are found in the main stem of Bear Creek and its associated irrigation canals, and these levels generally increase in a downstream direction. High concentrations of suspended sediments are indicated by the buildup of fine sediments behind diversion dams, over and within channel gravels, and along the irrigation canals. Granitic soil deposits in the upper reaches of Bear Creek are carried through the complex irrigation system during the irrigation season, and the major source of this sediment is believed by the RVCOG to be the erosion of the fragile granitic soils of the Ashland stock batholith. Although the Ashland Creek watershed may be a major source of these sediments, granitic sediment occurs in large amounts in Neil Creek, which drains part of the Ashland stock batholith. The upper reaches of Wagner Creek may also contribute granitic sediments to Bear Creek. Nongranitic sediments are produced in other creek watersheds, as well as on the valley floor.

FIGURE 2-6

MONTHLY SUSPENDED SOLIDS CONCENTRATIONS IN BEAR CREEK



SOURCE: A PRELIMINARY ASSESSMENT OF WATER QUALITY & RURAL NON-POINT SOURCES IN THE BEAR CREEK BASIN, JACKSON COUNTY, OREGON (JOHN LaRIVIERE, 1977)

High levels of turbidity in Bear Creek and the irrigation canals during the irrigation season appear to be caused by clay soils which originate from the eastern side of the basin and the valley floor. The fine colloidal clay particles enter the system as a result of irrigation practices, watershed erosion and canal bank erosion. Due to the natural variability of turbidity levels within the basin, the many factors which contribute to it, and the complex flow patterns within the irrigation system, the DEQ turbidity standard of a maximum increase of 10 percent over natural background levels is difficult to apply to nonpoint sources (LaRiviere, 1977). No standard violations have been identified, except for violations during the cleaning of Reeder Reservoir.

The buildup of sediments within the main stem of Bear Creek and in the interconnected system of irrigation canals adversely affects irrigation operations. The accumulation of sediments in Bear Creek also results in the compaction and burying of stream gravels, eliminating valuable salmonid spawning and rearing habitat. Both of these conditions violate the DEQ water quality standards for bottom deposits.

Temperature. Water temperature is a key regulator of biological activity in aquatic environments. Stream temperatures may vary diurnally, seasonally and with flow volumes. Temperature is one determinant of the organisms present as well as their distribution, rate of growth, and development (Hynes, 1970). When sufficient nutrients are present, high water temperatures may stimulate the growth of nuisance aquatic vegetation, encroaching on channel gravels and contributing to sediment buildup in the streambed.

Due to the large natural variability in stream temperatures within the Bear Creek Basin, DEQ has set point source discharge temperature limits according to the existing background temperature of the receiving stream (DEQ, 1976). No temperature increases are allowed when stream temperatures are 58°F or greater. No more than a 0.5°F increase due to a single source discharge is allowed when stream temperatures are 57.5°F or less, or a 2°F increase due to all sources combined when stream temperatures are 56°F or less (LaRiviere, 1977).

The streams and canals within the Bear Creek Basin all exhibit temperature variations that reflect changes in seasonal ambient air temperatures. Summer water temperatures usually exceed 68°F making Bear Creek unsuitable as habitat for salmon and steelhead from June to September. The diversion of water during the irrigation season also increases water temperatures by 5° to 9°F due to low stream flows, increased water surface area, and the absorbing and retaining of heat by suspended sediment and planktonic material (LaRiviere, 1977).

Dissolved Oxygen. Dissolved oxygen levels in stream systems are dependent on the physical, chemical and biochemical activities which are occurring and are important to the survival of most aquatic organisms. The oxygen content of stream waters is a key indicator of water pollution levels due to organic waste discharges since oxygen is used in the biological breakdown of organic materials in the stream environment.

In small turbulent streams the oxygen content of the water is normally near or above the 100 percent saturation level; however, in slow-moving, sluggish streams DO levels may frequently drop below 100 percent saturation due to the respiratory demands of aquatic organisms and the accumulation of dead organic matter. The solubility of oxygen in water varies inversely with the temperature, leading to lower concentrations of dissolved oxygen at 100 percent saturation during the warm summer months (Hynes, 1970).

Depleted oxygen may be replaced by the photosynthetic activity of aquatic plants or by absorption of atmospheric oxygen in riffles and waterfalls. Diurnal peaks in DO levels may result from the photosynthetic activity of aquatic plants. Low DO levels adversely affect fish and aquatic invertebrates on which they feed, and the depletion of oxygen can lead to the development of anaerobic conditions with associated odor and aesthetic problems (LaRiviere, 1977).

DEQ standards for DO in Bear Creek and its tributaries require a minimum of 90 percent saturation during the summer low flow period and 95 percent saturation in spawning areas during spawning, incubation, hatching and fry stages of the salmonids found in the basin, which occur primarily during the winter and spring (DEQ, 1976).

A monthly survey of DO saturation levels in Bear Creek and its tributaries during 1975-1976 as part of the RVCOG "208" program revealed that DO levels are generally in compliance with the established standards; however, occasional violations of the 90 percent saturation standard during the summer in Griffin, Crooked, Hansen, Anderson and Neil Creeks indicated that some summertime DO problems may exist, due to the nutrient loading of the streams from agricultural runoff, although the extent of the problem has not been determined (LaRiviere, 1977).

pH. pH is a measure of hydrogen ion activity or the acidity or alkalinity of water, and is measured in standard units with pH 7.0 being neutral on a scale of 0 to 14 from acidic to basic. The photosynthetic activity of aquatic plants uses carbon dioxide, and streams with large growths of aquatic vegetation may experience diurnal pH values as high 9.0.

The water quality standards established by DEQ for pH are 6.5 to 8.5, which is the range characteristic of most natural waters in the United States. The waters of Bear Creek and its tributaries tend to be alkaline (above 7.0), and more than half the stations sampled as part of the RVCOG "208" program recorded pH values in excess of 8.5 on one or more occasions. Since they often correspond to peaks of DO they were attributed to the photosynthetic activity of aquatic plants (laRiviere, 1977).

Nutrients. Nitrogen and phosphorus are two of the primary nutrients utilized by aquatic plants. The natural source of these nutrients in streams is rainfall, surface runoff and bank erosion. Drainage from agricultural lands also produces large amounts of nitrogen and phosphorus as does domestic sewage effluent. Nutrient loading of streams causes excessive growth of aquatic vegetation which in turn may cause fluctuations in DO and pH values that may adversely affect fish and aquatic invertebrates.

There are no specific water quality standards established by DEQ for these nutrients.

Data provided by the RVCOG "208" water quality sampling program indicate that nitrogen and phosphorus concentrations in Bear Creek and its tributaries are high as compared to the more natural conditions exhibited in Emigrant Creek, above the reservoir. The specific nutrients sampled included organic and inorganic nitrogen, total orthophosphate and total phosphorus (LaRiviere, 1977).

Although sufficient data are not currently available to assess its effects, nutrient loading of the Bear Creek Basin during the irrigation season may be a key factor contributing to the summertime DO and pH problems which have been identified by the RVCOG "208" sampling program. High nutrient levels may cause the excessive growth of aquatic vegetation, leading to periodic oxygen depletion and high pH levels which threaten the aquatic life of the streams.

Inorganic nitrogen (nitrate and nitrite) enters the stream from many natural sources including rain water and the decomposition of organic material, and man-caused sources including industrial and municipal waste treatment facilities and runoff from urban and agricultural areas. Waste discharges from the Ashland sewage treatment plant were found to increase organic nitrogen levels in Bear Creek due to the limited dilution capacity of the receiving stream during low flow periods. The inorganic nitrogen concentration in Bear Creek increases steadily downstream. Although this same downstream trend continues, there is an overall decrease in these concentrations during the irrigation season, indicating that some inorganic nitrogen is being removed from the water by the growth of aquatic plants and agricultural crops (LaRiviere, 1977).

The levels of organic nitrogen observed seem to follow a pattern similar to that described for inorganic nitrogen, with a progressive increase downstream and a slight decrease during the irrigation season. The highest levels of organic nitrogen recorded were on Ashland Creek during February and March, corresponding to the period of sluicing of Reeder Reservoir. These high levels were probably due to the buildup of organic materials on the bottom of the reservoir. (LaRiviere, 1977).

Both total phosphorus (TP) and total orthophosphate (PO_4) concentrations showed a downstream increase in Bear Creek, partly due to the influence of effluent from the Ashland sewage treatment plant. All of the tributary streams, with the exception of Ashland Creek, showed an increase in PO_4 levels during the summer months, which may be, in part, due to irrigation return flows.

Fecal Coliform Bacteria. Fecal coliform bacteria are common to the intestinal tracts of man and other warm-blooded animals, and their presence in water indicates contamination by fecal materials, as well as the possible presence of pathogenic organisms.

DEQ standards do not specifically address fecal coliform bacteria, but rather set a concentration limit for total coliform bacteria of 240 per 100 milliliters, except during periods of high natural surface runoff.

LaRiviere (1977) found that all sampling stations in the Bear Creek Basin recorded fecal coliform concentrations greater than 1,000 per 100 milliliters on one or more occasions during the year, with the exception of the two stations on Emigrant Creek. Due to persistent violations of the DEQ fecal coliform standard the Jackson County Health Department has identified several of the streams in the basin as health hazards, including Bear, Jackson, Griffin, Crooked, Carson, Wagner, Coleman and Neil Creeks. Although enough data are not available to define the exact cause of the bacterial contamination, LaRiviere (1977) assumes that part of the problem is due to failing septic drainfields or illegal discharge of septic tank effluent to surface waters. The complexity of the irrigation system within the basin makes it impossible to accurately trace the sources of the bacterial contamination.

Other Parameters. According to LaRiviere (1977) the following water quality parameters do not occur at sufficient concentrations in Bear Creek to create obvious water quality problems: total dissolved solids, lead, mercury, oil and grease, pesticides, and biological oxygen demand.

Adequate Water Quality Standards. Water quality standards are established to provide a basis for maintaining water quality at a level sufficient to protect the beneficial uses of a stream under natural conditions (EPA, 1976). The beneficial water uses established by DEQ for the mainstem of Bear Creek are given in Appendix A and include public domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, spawning and rearing, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality.

The existing standards for temperature, dissolved oxygen, pH, turbidity and bottom sludge deposits are adequate to protect the beneficial uses of the stream relative to those parameters. However, during "... specifically limited duration activities which may be authorized by DEQ ... through the issuance of waste discharge permits, ... to accomodate legitimate uses ..." the water quality standards for temperature, turbidity and bottom sludge deposits may be waived, resulting in a potential for adverse impacts on the beneficial uses of the stream.

Water quality standards for coliform bacteria and nutrients in Bear Creek are insufficient to adequately protect the beneficial uses of the stream from point sources of discharge or are nonexistent. The coliform bacteria standard established by DEQ for Bear Creek to monitor and guard against pathogenic organisms is a "total coliform" measurement, rather than a specific measure of "fecal coliform" organisms, which indicates contamination by fecal material and the possible presence of pathogenic organisms. Since other organisms of the coliform group which are not associated with fecal material are included in a "total coliform" count, an accurate determination of the possible presence and abundance of pathogenic organisms in a water supply cannot be made using a "total coliform" measurement such as employed in the DEQ standard (EPA, 1967). Also, the DEQ standard of 1,000 organisms per 100 milliliters is five times that of the 200 per 100 milliliters measure suggested by EPA (1976) for bathing waters.

Nutrient loading of Bear Creek and its tributary stream due to sewage effluent discharge and agricultural runoff is suspected as the major cause of aquatic vegetation growth within the basin streams. The growth of aquatic vegetation adversely affects DO and pH levels during low flow periods and is a nuisance in the irrigation canals. The growth of algal and rooted aquatic vegetation may also adversely affect aesthetic and recreation uses. At present there are no DEQ standards for regulation of nutrient levels in the Bear Creek Basin (LaRiviere, 1977).

Application of water quality standards to nonpoint source pollution presents particular difficulties. Increases in turbidity, suspended sediment and temperature levels within Bear Creek which may adversely affect the beneficial uses of the stream have all been attributed to nonpoint sources of activity within the basin, including silvicultural practices in the Ashland watershed, agricultural runoff, and operation of the basin irrigation system (LaRiviere, 1977). Due to the widespread nature of the nonpoint source activities, however, it is difficult to distinguish their effects from changes in natural background levels of water quality within the basin and to identify specific sources of pollution. Since the standards for these parameters require the demonstration of a deviation from "natural background levels", due to an "identifiable source", their enforcement is very difficult (DEQ, 1976). Beneficial uses may be jeopardized in the absence of such enforcement.

Vegetation

Bear Creek Basin is on the eastern edge of the Siskiyou ecological province of southwest Oregon and northern California. The native plant communities of the area include the coniferous forests of the Ashland watershed and surrounding ridges, oak savannah and grasslands in the foothill areas, mixed hardwood bottom land communities on the valley floor, and cottonwood-willow floodplain vegetation along Bear Creek and its tributaries (USDA, 1975). The forest, woodland and riparian plant communities reduce surface runoff rates and increase infiltration rates, contributing to subsurface flow. In this way the vegetative cover acts to reduce flooding and erosion of the soils in the watershed (Kittredge, 1948).

Much of the native vegetation of the foothill and valley areas has been removed and replaced by cultivated crops, orchards, pastureland and grazing areas. As a result much of the vegetation in the valley is a mosaic of irrigated pasture, alfalfa, orchards, truck crops and riparian habitat along the stream drainages. Uncultivated edges of agricultural lands are typified by annual grasses such as bentgrass, brome and wild rye, and weed and forb species such as yellowstar thistle, yarrow, wild carrot and American vetch.

Mixed Conifer/Pine Forests. The mountainous areas along the southwest side of the valley, such as the Ashland watershed, are dominated by Douglas fir with ponderosa pine and cedar present in some areas, along with deer brush, poison oak and manzanita. These are generally the areas that have been subject to forest management.

Oak Woodland and Shrub Communities. The foothill areas of the valley contain California black oak, Oregon white oak, deer brush, white-leaved manzanita, poison oak and birchleaf mountain mahogany, as well as scattered ponderosa pine and cedar (Franklin and Dryness, 1969).

Riparian. The vegetation of the floodplain areas is dominated by dense thickets of black cottonwood and willow. Scattered white alder trees are often present, as well as an occasional big-leaf maple and Oregon ash. The native understory includes a variety of species such as herbaceous sagebrush, blue wild rye, cattail and horsetail; however, in many areas the Himalaya blackberry has been introduced and readily becomes the dominant understory species (USDA, 1975).

Wildlife

A wide variety of wildlife species is associated with the plant communities of the Bear Creek Basin.

The black-tailed deer is the most common of the big game mammals in the area, and the black bear and the mountain lion occur in the more remote portions of the basin. Game birds found in the area include the band-tailed pigeon, mountain quail, California quail, mourning dove and ring-necked pheasant (Jones & Stokes Associates, 1977).

The riparian plant community provides nesting and feeding habitat for many species of birds, mammals, reptiles, amphibians and fish. Local terrestrial species found in the habitat include 113 birds, 50 mammals and 10 reptiles. Aquatic species found associated with the riparian habitat include 41 aquatic birds, 5 mammals, 2 reptiles, 7 amphibians and 17 fish (Cross, 1975; Ballard, et al., 1975; Hostick, 1976).

Threatened or Endangered Wildlife. Three species of wildlife, identified by the U. S. Department of the Interior (1973) and the Oregon Wildlife Commission (1975) as endangered or threatened with extinction, could occur within the Bear Creek Basin. These include the American peregrine falcon, northern bald eagle, and northern spotted owl. Both the peregrine falcon and the bald eagle have been observed flying in the valley area, and the northern spotted owl is suspected to nest in the mountainous areas along the southwest side of the valley (Hostick, pers. comm.).

Recreation

Bear Creek, its tributaries, and the Rogue River are focal points for recreation in the area. Bear Creek provides fishing, hiking, picnicking, bird watching, and other passive uses. Some body contact recreation occurs during the warmer months.

The entire creek corridor has been designated as the Bear Creek Greenway, a natural resource, open space, and recreational corridor. Jackson County and other agencies are in the process of acquiring lands along Bear Creek and its tributaries, including Ashland Creek from Lithia Park downstream, for preservation and further recreational development. Portions in Medford feature a bike trail and other bike trail segments are proposed.

Lithia Park in Ashland, located along Ashland Creek, and adjacent to the Shakespeare Festival grounds, is noted throughout Oregon and much of the west for its beauty, including gardens, well-kept lawns, and mature trees. Upstream, Reeder Reservoir is closed to general public use. Recreational use of the watershed lands above the reservoir is light, confined to hiking, picnicking, and seasonal use of the Mount Ashland Ski development on the higher slopes.

The Rogue River is popular for fishing, boating, picnicking, camping, and passive uses. It is an important salmonid stream, and draws fishermen from great distances. Public Law 90-542 designated an 84-mile segment of the Rogue as part of the National Wild and Scenic Rivers System. The designation covers the Rogue from near Grants Pass downstream to Lobster Creek.

Historic and Cultural Resources

Very little archeology study has been accomplished in the Rogue River drainage basin, particularly in the vicinity of Bear Creek Valley. The earliest published work was accomplished by Luther Cressman (1933a; 1933b) in 1931 and 1932 at Gold Hill, Oregon. He recovered what may be some early flexed burials. Included among the grave offerings were large obsidian blades and leaf-shaped projectile points. Later material overlaid the burials (Jones & Stokes, 1977).

Wilbur Davis excavated several archeological sites in the Lost Creek and Elk Creek vicinities in 1967, 1968, 1972 and 1973 (Davis, 1968, 1970, 1974). Davis' work was a forerunner to hydroelectric dam construction on the two streams. Davis' work has established a cultural history along the upper Rogue River extending back at least 6,000 years. Encompassed within this 6,000-year period are four provisionally-defined phases (Davis, 1974).

The first known European contacts in the Rogue Valley occurred in the early 1800s. Further exploration and trapping for furs followed. Conflicts with the native Indians began in the late 1820s and led to great conflicts by the 1850s. By 1856 the Indians were reduced to small numbers and were taken to the Siletz Reservation.

Settlement continued, based on some gold discoveries, with later permanent developments based on agriculture. The railroad shaped the Bear Creek Valley growth further, aiding the growth of Medford and Ashland, at the expense of such communities as Jacksonville, bypassed by the rails.

Historic sites exist in numerous places in the Bear Creek basin. Several structures in Ashland are in the *National Register of Historic Places*, as are sites in Medford and Butte Falls.

In August 1967 Jacksonville was dedicated as a national historic landmark, a distinction that led to its being placed upon the *National Register of Historic Places* and making it one of four residential communities to be so dedicated in the United States. Originally, the historic area was comprised of and confined to 4-½ square blocks within the downtown area. In 1972, however, the historic core was expanded to include a majority of downtown buildings. Also included was the site where gold was originally discovered near Jacksonville (Jones & Stokes, 1977).

Anadromous Fisheries of Bear Creek

The Rogue River basin has historically supported some of the largest runs of anadromous salmonids on the west coast of the United States. As part of the Rogue River system, Bear Creek and its tributary streams have served as spawning and nursery areas for fall run chinook salmon (*Oncorhynchus tshawyscha*), coho or silver salmon (*O. kisutch*), sea-run cutthroat trout (*Salmo clarki*), and summer and winter run populations of steelhead trout (*S. gairdneri*) (ODFW, 1964). Because of this, the Bear Creek drainage is considered to be a sensitive aquatic habitat in which successful anadromous fish production is dependent on a quality environment (Haight, pers. comm.).

Life History Characteristics and Resource Needs

At present the only anadromous salmonids which inhabit the Bear Creek Basin are fall run chinook and coho salmon, and summer and winter steelhead trout. Critical periods for the key life history stages of these anadromous salmonids and their physical resource needs are described in the "Environmental Criteria Guidelines" given for each species in Appendix D. The criteria are based on information provided by the ODFW and additional literature on the biology of anadromous fishes. The activity/life stage dates given in the criteria charts for each species are used to identify periods during which the fish may be especially vulnerable to environmental changes. The indicated time periods may vary from year to year due to shifting climatic conditions which cause changes in stream flow volume, velocity, temperature and other environmental factors. Readers wishing additional background on the life history should refer to a classic reference, such as Leo Shapovalov, and A. C. Taft, 1954, *The Life History of the Steelhead Rainbow Trout (Salmo gairdneri gairdneri) and Silver Salmon (Oncorhynchus kisutch) with Special Reference to Waddell Creek, California, and Recommendations Regarding Their Management* (California Department of Fish and Game, Fish Bulletin No. 98).

Steelhead Trout. The steelhead fishery is composed of both summer and winter run steelhead. About 550 summer steelhead enter Bear Creek and move up into its tributaries (if access is available) beginning in December and January as flows in the drainage are increasing, and spawn in suitable gravel bottom areas from late December through March. A total of approximately 25 miles of summer steelhead rearing habitat exists in 13 of the tributary streams entering Bear Creek (Table 2-2). Incubation of the eggs in the gravel beds lasts from late December to May, and emergence of the newly hatched fry occurs from March through May. As water levels drop and temperatures increase during the late spring, most of the young fry move down from the tributary streams into the mainstem of Bear Creek and on into the Rogue River where water flows and temperatures are suitable, remaining in the river for 1 to 3 years before migrating to the ocean. If access is available, some of the young seek out suitable summer water temperatures by moving up into the upper reaches of some of the perennial streams such as Walker, Frog and Neil Creeks in the southern part of the Bear Creek Basin. These streams are the only ones which still have sufficient summer flows to provide rearing areas for young salmonids (Haight, pers. comm.).

Winter run steelhead, which number about 300, move up into Bear Creek beginning in February; spawning occurs from late March through May, and is limited to the 27 miles of the mainstem of Bear Creek (Table 2-2). In years when sufficient late spring flows occur, winter run steelhead also spawn in the tributary streams (Haight, pers, comm.). Incubation of eggs lasts from late March through July, emergence of fry occurs from April to July, and the young move downstream to the Rogue River or up into the headwaters of the tributary streams. When tributary flows decrease in late summer and early fall, the young may have to move downstream into Bear Creek to survive, and ascend into the tributary streams again in the late fall when stream flows begin to rise. The young fish remain in fresh water from 1 to 3 years before migrating to the ocean.

Environmental conditions conducive to steelhead trout production in the Bear Creek Basin include minimum depths of at least 0.5 feet, water velocities of 1-3 fps, and temperatures from 43 to 55°F. Minimum dissolved oxygen levels of 7 ppm are necessary for normal growth, and channel gravels with less than 20 percent fine sediments content are required for spawning, egg development, fry emergence and rearing of the young. Although steelhead can clear individual 2- to 3-foot barriers when a jumping pool of sufficient depth is present, single barriers with no downstream jumping pool or multiple barriers in a close series should be no greater than 1 foot to permit fish passage (USDA, 1977). Water depths of at least 0.6 foot and velocities of less than 8 fps are also necessary for fish passage.

Coho Salmon. Although steelhead are hearty and somewhat adaptable to man-made changes in water quality and stream flow characteristics, coho salmon are very sensitive to such changes. As a result, coho salmon now occur in only limited numbers in the Bear Creek drainage even though many of the tributary streams historically provided spawning and rearing habitat. Adult coho salmon enter Bear Creek during November and December, and spawn from November through January throughout the 27 miles of the mainstem (Table 2-2) and in some tributary streams if access is available. Emergence of fry occurs from February through April. The young remain in their spawning streams until the following spring when they migrate to the ocean (Haight, pers. comm.).

Environmental conditions conducive to coho salmon production in Bear Creek are similar to those described for steelhead trout.

Chinook Salmon. The remnant chinook salmon run in Bear Creek begins around the first of October if flows are adequate, with spawning beginning during the latter half of October and continuing through December in the lower 7 miles of Bear Creek from Talent to the Rogue River (Table 2-2). Incubation of eggs lasts until late March. The fry emerge during February and March, and soon migrate to the ocean (Haight, pers. comm.).

Table 2-2

ESTIMATED NUMBER AND DISTRIBUTION OF ADULT SPAWNING SALMONIDS
IN THE BEAR CREEK DRAINAGE
(Based on Stream Habitat Inventory ODFW, 1970)

Stream	Summer Steelhead		Winter Steelhead		Coho Salmon		Chinook Salmon	
	Number of Fish	Miles of Available Rearing Habitat	Number of Fish	Miles of Available Rearing Habitat	Number of Fish	Miles of Available Rearing Habitat	Number of Fish	Miles of Available Rearing Habitat
Bear Creek	0	0	300	27	60	27	50	7
Willow Creek	20	1						
Jackson Creek	30	2						
Griffin Creek	40	1.5						
Larsen Creek	20	0.5						
Coleman Creek	15	0.5						
Wagner Creek	75	2						
Meyer Creek	30	1						
Ashland Creek	50	5.5						
Neil Creek	75	5						
Clayton Creek	10	0.25						
Emigrant Creek	75	3.5						
Walker Creek	100	3.5						
Frog Creek	10	1						
Total Fish	550		300		60		50	

The environmental needs of chinook salmon in Bear Creek are generally similar to those described for steelhead trout, although the larger body size of chinook salmon requires a minimum of 0.8 foot of water depth for adult passage and spawning.

Summary. In summary, the salmonid species seek habitat in the tributaries to Bear Creek all year, and in the mainstem of Bear Creek from about October through July. The steelhead, coho salmon and chinook salmon follow different natural time tables, with the greatest fish populations inhabiting Bear Creek from about January through May, coinciding with the periods of highest natural streamflow. From October through July, and especially from January through May, sufficient flows must be available for the in- and out-migration of adults, as well as smolting juveniles on their way to the ocean. Stream habitat with sufficient water depth, flow and temperature as well as suitable spawning gravels must also be available for spawning, the rearing of the young, and their movement up into tributary headwater streams or down into the Rogue River where summer water temperatures are suitable. A summary of the critical life history stages of the salmonids of the Bear Creek Basin are presented in Table 2-3.

Relationship of Salmonid Fishery to Stream Hydrology

The life history characteristics and resource needs of anadromous salmonids when in the Bear Creek Basin are intimately related to its natural, unregulated stream flow regime. High winter and spring flow volumes affect adult passage, spawning, egg development, and rearing of the young and juvenile outmigration directly by providing water of adequate depth, velocity, temperature and dissolved oxygen content. Habitat suitability for spawning, egg development, and rearing of the young is also affected indirectly by high winter and spring stream flows which scour the streambed, keeping the gravels loose and free of fine sediments, and removing riparian vegetation from the stream channel.

The quality of salmonid habitat in streams that have controlled flows is often seriously degraded due to the compaction of gravels resulting from the accumulation of sediments and the encroachment of riparian vegetation into the stream channel (Barracco, 1977). Compaction of stream gravels with fine sediments reduces or eliminates the intergravel spaces, adversely affecting the success of salmonid egg incubation and hatching and the emergence and rearing of the fry (Phillips, 1971; Shumway, et al., 1964; Sheridan, 1962). Successful development of the eggs requires a subsurface flow through the spawning gravels to supply the needed oxygen (5-7 ppm) and remove metabolites.

Table 2-3

CRITICAL PERIODS FOR THE LIFE HISTORY STAGES OF ANADROMOUS SALMONIDS WHICH OCCUR IN THE MAINSTEM OF BEAR CREEK

Species	Estimated Number of Spawning Adults	Adult Passage	Spawning	Egg Incubation	Rearing	Smolt Passage
Summer Steelhead	550	Dec-Mar	Dec-Mar[1]	Dec-May[1]	All Year[2]	Mar-May
Winter Steelhead	300	Feb-May	Mar-May	Mar-Jul	All Year[2]	Mar-May
Coho Salmon	60	Nov-Dec	Nov-Jan	Nov-Mar	All Year	Mar-May
Chinook Salmon (fall run)	50	Oct-Dec	Oct-Dec	Oct-Mar	Mar-Jun	-[3]

[1] Tributaries.
[2] Bear Creek in late summer and fall, in tributaries rest of year.
[3] In Rogue River.

After hatching the sacfry or alevins must have open space in the gravel to emerge. Once the fry have emerged, they use the gravel space for cover and feeding before moving to pool areas as juveniles. Intergravel spaces also serve as habitat for many of the aquatic insects on which young salmonids feed while in fresh water (Cordone and Kelley, 1960; Phillips, 1971).

During the summer months under natural conditions the mainstem of Bear Creek and the lower reaches of its tributary streams was historically often dry or nearly so, and juvenile salmonid rearing habitat was limited to the upper reaches of the tributary streams where natural water temperatures were suitable.

Man-Made Changes Affecting the Anadromous Fishery

Since the early 1900s, agricultural and urban development in the Bear Creek Valley has significantly altered the physical environment. With the construction of Emigrant Reservoir in 1924, Reeder Reservoir in 1928, and the heavy irrigation, municipal and industrial water demands which have developed in the basin, the natural flow patterns of Bear Creek and its tributaries have been changed dramatically, altering flow volumes, water quality and stream morphology (ODFW, 1964; DEQ, 1977). As a result of these changes plus the effects of agricultural practices, logging, road building, gravel mining, urbanization, and municipal and industrial sewage productions, much of the salmonid spawning and nursery habitat in the Bear Creek drainage has been degraded or eliminated (ODFW, 1970; Haight, pers. comm.).

As a result of land use changes within the basin, sediments contributed by tributary streams and the flushing of Reeder Reservoir have built up in Bear Creek, especially in its lower reaches, eliminating salmonid habitat (Haight, pers. comm.). The more constant flow regime, particularly the maintenance of summer flows at levels much higher than historic values, has also encouraged vegetation encroachment on the streambed, with consequential decreases in stream gravel areas.

The operation of the complex irrigation system within the Bear Creek Basin from the first of April to the end of October may have a number of adverse effects on the salmonid fishery. Diversion structures may interfere with the movement of the salmonid species into the tributary streams or out into the Rogue, and reduced streamflow below diversions may increase predation. Adverse water quality changes also affect the fish.

Releases from Emigrant Reservoir, irrigation return flows, elevated water temperatures and high nutrient levels from agricultural runoff and municipal sewage effluent provide conditions conducive to the growth of aquatic vegetation. The growth of the aquatic vegetation binds the stream channel gravels, thus degrading the quality of salmonid spawning and juvenile rearing areas within Bear Creek and the tributary streams. Summer flows in Bear Creek also provide suitable habitat for warmwater fish species such as black bass, black crappie and sunfish which feed on juvenile salmonids (Haight, pers. comm.). High turbidity levels throughout the irrigation season may also have an adverse affect on adult and juvenile salmon in the Bear Creek Basin (ODFW, 1970).

Three major irrigation diversions are operated along Bear Creek, with significant effects on summer creek flow during the irrigation season. Figure 2-7 illustrates these effects on relative streamflow along Bear Creek. These conditions may act to inhibit the upstream movement of winter steelhead in Bear Creek during April and May. The ODFW has found that all three of the diversion dams have a significant adverse effect on the upstream migration of winter steelhead during years when flows are low (Jennings, pers. comm.).

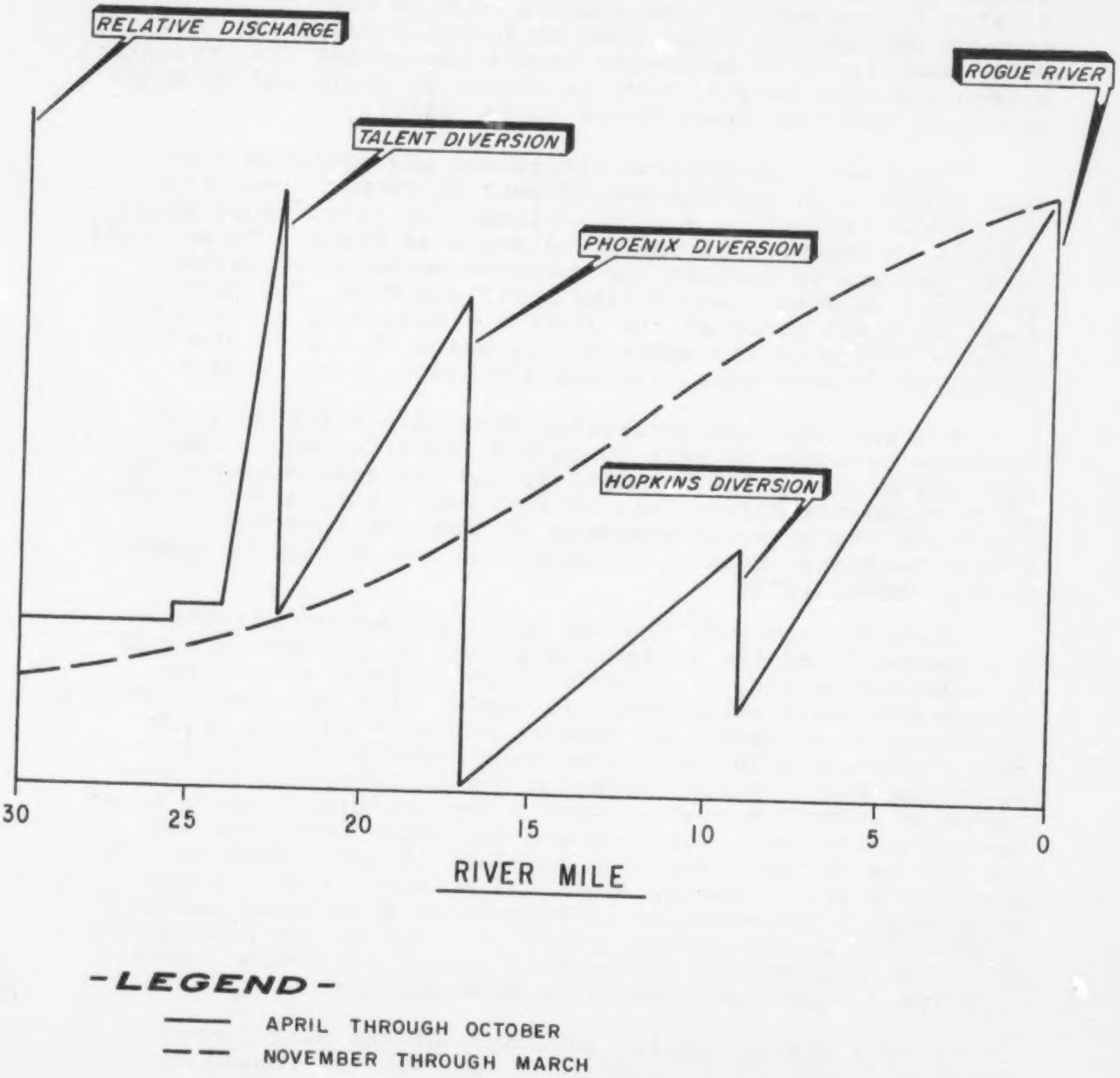
The placement of irrigation diversion structures on both the mainstem of Bear Creek and its tributary streams also presents partial barriers to the upstream movement of adult salmonids during fall, winter and spring spawning migrations and the upstream movement of juvenile salmonids to stream headwater rearing areas during the spring and summer months (ODFW, 1970).

Although the ODFW has not investigated the effects of the operation of the irrigation system on the outmigration of salmonid smolts, the complex flow patterns within the system may cause an increase in travel time of salmonid smolts, resulting in an increased time of exposure to high water temperatures within the system and predation from birds and warmwater fish. Before entering the saltwater environment juvenile salmonids must undergo a physiological change known as smoltification. This process cannot be completed nor can the smolt condition be maintained at water temperatures above 59°F (15°C) (Zaug, Adams and McLain, 1972). Since mean monthly temperatures in Bear Creek at Medford approach 59°F (15°C) in May (RVCOG, 1976), a delay of the outmigration of juvenile salmonids during this period may cause desmoltification and prevent successful outmigration.

A 1970 Stream Habitat Inventory of the Bear Creek Drainage (ODFW, 1970) identified fish habitat losses due to man-made changes. Damage to stream habitat within Bear Creek included chemical pollution from orchard spraying and domestic sewage, siltation of the streambed and high turbidity

FIGURE 2-7

TYPICAL FLOW PROFILE
BEAR CREEK



NOTE: A PRELIMINARY ASSESSMENT OF WATER QUALITY & RURAL NON-POINT SOURCES IN THE BEAR CREEK BASIN, JACKSON COUNTY, OREGON. JOHN LaRIVIERE, 1977.

throughout the 27 miles of stream due to land use practices and 14 miles of man-caused channel changes and 10 miles of stream bank habitat destroyed. A survey of the tributary streams also revealed a general destruction of fish habitat due to man-made changes. Identified were 22 miles of chemical pollution due to orchard spraying, 11 miles of man-made channel changes, 6 miles of stream bank habitat destroyed, 39.5 miles of streambed silted, 62.5 miles of high turbidity due to land use practices and 4 miles of man-caused channel drying.

Sediments originating in Ashland Creek are a contributing factor in turbidity and siltation during sluicing or dredging of Reeder Reservoir, and sediments discharged from the reservoir may remain in Bear Creek for some period thereafter. The effects of dredging Reeder Reservoir following the 1974 flood on the salmonid fisheries of Bear Creek were documented in the Upper Rogue District Monthly Report, August 1974 for the ODFW:

> "The bed of Bear Creek between the mouth of Ashland Creek and the Jackson Street diversion in Medford is choked with decomposed granite, up to 10 inches deep in areas, following dredging of Reeder Reservoir by the City of Ashland. Four 100-yard sections of stream were examined on August 1 and 2, and steelhead fry were found to be absent, as are most species and age classes of insects."

Based on field sampling conducted during 1974, the ODFW concluded that virtually all of the fall chinook, coho salmon and winter steelhead spawn was lost due to sediment release from Reeder Reservoir. Summer steelhead fry survived until they returned to Bear Creek in the summer as flows in the tributaries decreased. They died after reentering Bear Creek (Haight, pers. comm.). Although no sampling was conducted subsequent to 1974, it is assumed by the ODFW that the silting of the mainstem of Bear Creek had a residual adverse impact on salmonid production within the basin, although the duration and magnitude of the impacts is not known (Jennings, pers. comm.).

Salmon and steelhead reared in the Bear Creek Basin are caught by both sport and commercial fishermen in the ocean and the Rogue River (Bear Creek is not open to fishing for these species [Jennings, pers. comm.]). The economic losses to commercial and sports fishermen due to the virtual elimination of salmonids spawned in Bear Creek in 1974 was calculated by the ODFW using their 1975 Economic Data Catalogue (Table 2-4). The ODFW's 1970 estimate of the number of adult spawners (escapement) within the Bear Creek system, and established catch-to-escapement ratios, were used to estimate the number of fish of each species lost from the sport and commercial fish catch for one year. These values were then used to estimate an economic loss of $67,468 in 1975 dollars.

Table 2-4

ECONOMIC LOSSES OF THE ANADROMOUS SALMONID FISHERY IN THE BEAR CREEK BASIN DUE TO THE 1974 DREDGING OF REEDER RESERVOIR

(based on information provided by the ODFW)

Stream	Species	Number of adult fish estimated to be returning to spawn in 1974[1] (escapement)	Estimated number of fish lost from the sport catch due to 1974 sediment discharges	Economic value of sport catch losses due to 1974 sediment discharges	Estimated number of fish lost from the commercial catch due to 1974 sediment discharges	Economic value of commercial catch losses due to 1974 sediment discharges
Bear Creek	Chinook Salmon (fall run)	50	72	$ 7,318	177	$2,994
	Coho Salmon	60	87	785	213	315
	Winter Steelhead	300	180	22,176		
Willow Creek	Summer Steelhead	20	10	1,241		
Jackson Creek	Summer Steelhead	30	15	1,861		
Griffin Creek	Summer Steelhead	40	20	2,483		
Larsen Creek	Summer Steelhead	20	10	1,241		
Coleman Creek	Summer Steelhead	15	7	869		
Wagner Creek	Summer Steelhead	75	37	4,592		
Meyer Creek	Summer Steelhead	30	15	1,861		
Ashland Creek	Summer Steelhead	50	25	3,102		
Neil Creek	Summer Steelhead	75	37	4,592		
Clayton Creek	Summer Steelhead	10	5	621		
Emigrant Creek	Summer Steelhead	75	37	4,592		
Walker Creek	Summer Steelhead	100	50	6,204		
Frog Creek	Summer Steelhead	10	5	621		
TOTALS		960	612	$64,159	390	$3,309

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[1] Based on ODFW 1970 stream habitat inventory counts.

Field and Laboratory Analysis of Stream Gravels

A stream gravel analysis was conducted in March 1979 to determine the gravel size composition in potential or actual spawning areas in Bear Creek. The information was used to assess the suitability of the stream gravels as salmonid spawning and rearing habitat at the time the sampling was done. Since these samples were taken three years following the most recent cleaning of Reeder Reservoir, they were not expected to relate to any impacts from that source.

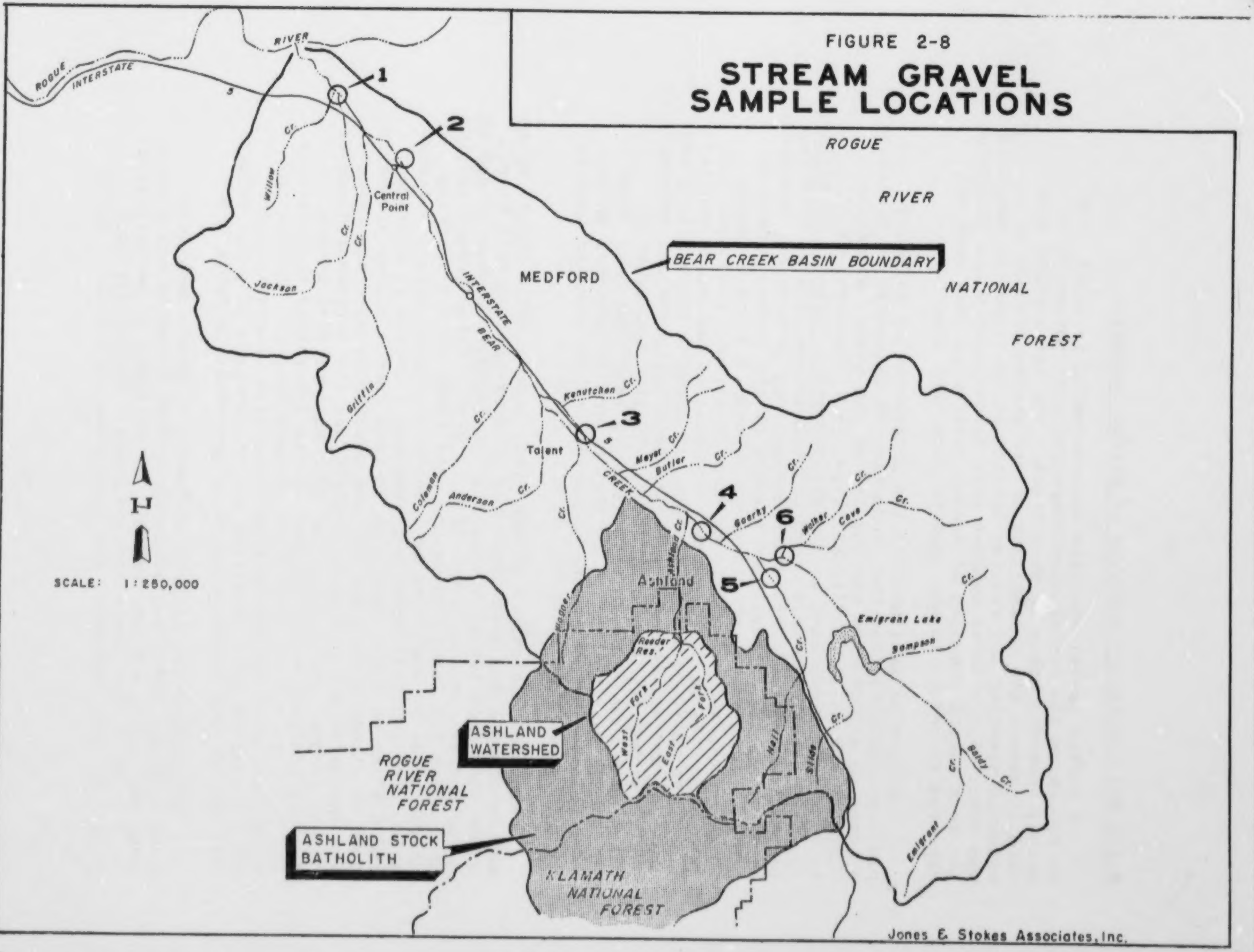
Information available in the literature on salmonid biology indicates that the production of salmonids in freshwater streams is affected by the quality of the gravel substrate (Cordone and Kelley, 1961; Phillips, 1971; Iwamoto, et al., 1978). As is indicated in the Environmental Criteria Guidelines for steelhead, coho salmon and chinook salmon, gravel substrate composition directly affects spawning, egg incubation, emergence of the fry, and disposal and rearing of the young. Spawning gravel for salmonids should range between 0.5 and 6 inches in diameter, and contain fewer than 20 percent fine sediments less than 0.84 mm in diameter. Accumulated sediments smaller than 0.84 mm (0.03 in) in diameter in channel gravels have been shown to smother eggs and inhibit the development and emergence of newly hatched fry (Iwamoto, et al., 1978). Sediments as large as 8.5 mm (0.34 in.) in diameter have also been shown to degrade rearing habitat by filling the intergravel spaces used as cover by both young salmonids and the aquatic insects on which they feed (Iwamoto, et al., 1978).

With the assistance of the ODFW, a total of 6 sample sites was selected along Bear Creek and on Emigrant and Neil Creeks which contained actual spawning sites (redds) or were judged to be potential spawning areas (Figure 2-8). Three gravel samples each about 1.5 liters in volume were taken in the spawning gravel areas at each site to a depth of approximately 7 inches using a cylindrical steel soil sampler 4 inches in diameter and 9.5 inches long, including 2½-inch curved blades projecting down on either side. The maximum spacing between the blades was approximately 2 inches, restricting the narrowest diameter of the largest rocks collected to a maximum of 2 inches. A sieve analysis was performed in the laboratory to determine the particle size distribution of each sample. The percent by weight of three separate particle size ranges in each of the samples was calculated and the average of these values for each of the 6 sample sites is presented in Table 2-5.

The proportion of fine sediments in Bear Creek less than 0.84 mm, which may adversely affect salmonid egg development and fry emergence, exceeds the critical 20 percent level at Station 4 just above Ashland Creek. Relatively high levels of fine sediments are also found at Station 3 below

FIGURE 2-8

STREAM GRAVEL SAMPLE LOCATIONS


ROGUE RIVER
INTERSTATE 5
1
2
3
4
5
6
Central Point
Willow Cr.
Jackson Cr.
Griffin Cr.
MEDFORD
INTERSTATE
BEAR CREEK
BEAR CREEK BASIN BOUNDARY
ROGUE RIVER NATIONAL FOREST
Kenutchen Cr.
Talent
Coleman Cr.
Anderson Cr.
Wagner Cr.
Meyer Cr.
Butler Cr.
Ashland Cr.
Bearky
Walker Cr.
Cove Cr.
Ashland
Reeder Res.
West Fork
East Fork
Hall
Slide Cr.
Emigrant Lake
Sampson
Baldy Cr.
Emigrant Cr.
ASHLAND WATERSHED
ROGUE RIVER NATIONAL FOREST
ASHLAND STOCK BATHOLITH
KLAMATH NATIONAL FOREST
SCALE: 1:250,000

Jones & Stokes Associates, Inc.

Ashland Creek and at Station 5 in lower Neil Creek, where values are twice those found in Emigrant Creek. These data indicate that Neil Creek, which drains part of the eastern slope of the Ashland stock batholith, may contribute significant amounts of fine granitic sediment to Bear Creek.

As expected, there was no indication of a fine sediment contribution from Ashland Creek at the time of sampling, since the granitic sediments originating in the Ashland watershed for the previous 3 years had been retained in Reeder Reservoir.

Larger fines within the range of 0.84 and 8.5 mm have been found in the spawning areas of undisturbed streams in concentrations as high as 33 percent (Burns, 1970), and fry emergence success, cover and food production has been shown to be affected at levels between 40 and 50 percent (Iwamoto, et al., 1978; Lantz, 1969).

The proportion of sediments within this range (0.84-8.5 mm) reported for Bear Creek show no consistent downstream trend. However, a peak value of 47 percent in lower Neil Creek, and a value of 40 percent in Bear Creek at Talent indicate marginal habitat.

In general, the data developed from the sampling indicate that at the time the sampling was done, that of those areas sampled, the only salmonid spawning and rearing areas adversely affected by the presence of excessive amounts of fine sediments were in lower Neil Creek and in Bear Creek above Ashland Creek. Marginal salmonid rearing habitat conditions were also indicated just below Ashland Creek in Bear Creek at Talent. Since the most recent silting of the mainstem of Bear Creek due to the flushing of Reeder Reservoir occurred in the spring of 1976, it may be concluded that the residual adverse impacts of that silting did not extend beyond a 3-year period.

Ashland Watershed

Hydrology

The hydrology of Ashland Creek is an important factor in evaluating the cleaning of Reeder Reservoir. Creek flows relate to the physical cleaning process, the city's water supply, and movement of sediments. An attempt has been made to present the known data on creek flows, illustrating the flow regime of the stream in normal, flood, and low stream flow periods.

The USGS has published daily stream gauge records for two gauging stations on Ashland Creek above Reeder Reservoir. Gauge 14353500 is located on the East Fork of Ashland Creek 0.1 mile above the diversion dam, upstream of Reeder Reservoir.

Table 2-5

PARTICLE SIZE COMPOSITION OF STREAM GRAVELS IN BEAR CREEK ILLUSTRATED AS PERCENT BY WEIGHT

	Particle Size Categories (mm)		
Station	>8.5 (.34 in)	8.5 - 0.841 (.34 - .03 in)	<0.841 (.03 in)
1. Bear Creek at confluence with Jackson Creek	56	32	12
2. Bear Creek at Central Point	61	27	12
3. Bear Creek at Talent	43	40	17
4. Bear Creek at Mountain St. (Ashland) upstream of confluence with Ashland Creek	47	32	21
5. Neil Creek	37	47	16
6. Emigrant Creek	56	36	8

Gauge 14353000 is located on the West Fork of Ashland Creek 0.3 mile upstream of the city's point of diversion for water supply. There are no diversions of water or impoundments on the streams upstream of the gauges. The gauges have developed 20 water years of record, including 12 years (September 1924 to January 1933 and December 1974 to the present) of daily flows (with a few estimated periods) and 8 years (water years 1954-1960 and 1963) of annual peak flow data.

The area tributary to the East Fork is 8.14 square miles, to the West Fork 10.5 square miles. Average flow tributary to the East Fork gauge is 8.19 cfs (5,930 AFY), to the West Fork gauge 7.99 cfs (5,790 AFY), based on water years 1925-1932 and 1976-1977. Median flows are about 5 cfs for each fork.

Below the gauges, the City of Ashland diverts water for municipal water supply purposes. The diversion can be made from Reeder Reservoir at Hosler Dam, or at each of the diversion structures on the East and West Forks. The diversions and Reeder Reservoir significantly modify downstream flows in Ashland Creek. The only reported gauging of the watershed other than the East and West Forks occurred from July to November 1913 on Ashland Creek at Ashland, probably at or near U. S. 99.

The City of Ashland maintains records of reservoir levels, diversions to municipal use, and limited records of releases to Ashland Creek from the dam and from the water treatment plant. Although these records could provide some estimates of flow in Ashland Creek below Reeder Reservoir for some periods, no attempt has been made to do so for this study, since the records are not continuous and omit high flow periods.

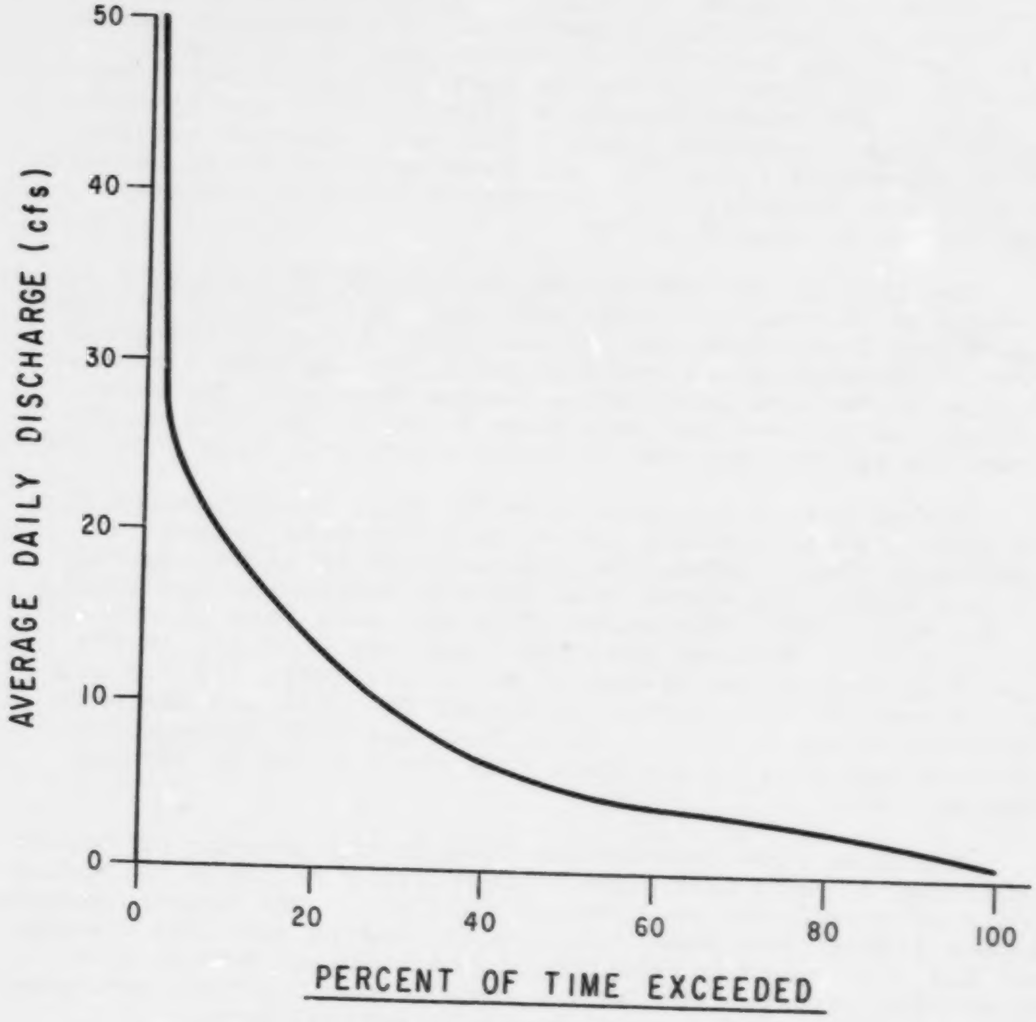
Figure 2-9 illustrates flow-duration relationships for the East Fork of Ashland Creek, based on USGS records of mean daily flow. Given the similarities in flows between the two forks, the curve also closely represents conditions on the West Fork. The median flow for each fork is approximately 5 cfs. Minimum recorded flows are 0.47 cfs on the East Fork during the freeze of March 14, 1977, and 1.3 cfs on the West Fork, recorded on August 29, 1931 and again on September 8 and 9, 1977. Other than the 1977 freeze, the previous low flow on the East Fork was 1.0 cfs on several days in 1931.

The base flow (continuing flow in the absence of recent rainfall) of each fork appears relatively reliable following years of normal and near-normal rainfall. The lowest combined summer inflow into Reeder Reservoir, during the 1931 drought, was 2.3 cfs, about one-fourth of the combined median flow of 10 cfs. Freezes can have a more dramatic effect on streamflow for periods of several hours to several days.

FIGURE 2-9

FLOW DURATION CURVE FOR

EAST FORK ASHLAND CREEK, USGS GAGE 14353500
BASED ON WATER YEARS 1926-32, 1976-77
USING AVERAGE DAILY FLOWS



Peak flood flows are less well documented than the low flow extremes. The 1974 flood, believed to be the greatest since at least 1900 (USGS, 1977), has been variously classified as a 30-year event (HUD, 1979) and an 800-year event. A discharge of 5,630 cfs was estimated for the East Fork, and 4,780 cfs for the West Fork, both on January 15, 1974.

The USGS indicates that the peak discharges from the January 1974 flood were estimated by the slope-area measurement method, using a visible high-water mark, and that the peaks were believed exagerated by releases from debris accumulating and forming dams and then breaking upstream. Ed Fallon of the City of Ashland confirms that, during the night of the flood, city crews were deflecting debris from the Reeder Reservoir spillway, but abandoned their positions upon hearing thunderous sounds in the distance, believed to be the debris dams giving way. Later inspection of abrasion to trees above the East and West Forks stream channels, and the presence of a great quantity of trees, stumps, branches and other debris in the reservoir further confirm that the measured flow was probably increased to a great degree by debris carried along as part of the crest of the flood (Fallon, pers. comm.).

An estimate of flow depth over the Reeder Reservoir spillway was made by the city. The application of weir discharge formulae led to later estimates of about 1,330 cfs by the city (Fallon, pers. comm.), far less than the peak inflow of over 10,000 cfs estimated by USGS. A second estimate of flow over the dam of a quantity closer to 2,000 cfs was reportedly made by the Corps of Engineers during their involvement in emergency repair work following the flood, but the Corps files in Portland yielded no confirmation of any such estimate. In any event, the inflow into Reeder Reservoir was certainly far greater than the estimated peak outflow of 1,330 cfs. Reeder Reservoir greatly reduced the downstream effects of this flood, removing debris, reducing peak flood flow rates and thereby preventing a potential disaster in Ashland. (Even when full, the reservoir retards flood flow as the water level rises over the spillway. A high rate of inflow lasting for several hours or less may spill over the dam at a lower rate for a day, for instance.)

HUD (1977) has prepared a preliminary flood insurance study of the City of Ashland that presents some hydrologic analyses relative to Ashland Creek. Log-Pearson Type III analyses, prepared for that study by USGS, based on 18 years of record, were used to develop flow-discharge relationships for the East and West Forks of Ashland Creek, along with other streams in their study area. From these frequency analyses, drainage area versus peak flow regression equations were developed to describe the frequency-discharge relationships as a function of watershed area. These equations were then applied to streams where gauging stations did not exist, but where frequency-discharge relationships were required for study purposes. This included Ashland Creek at the city.

Further, the HUD study cites the estimated 1,331 cfs discharge over Hosler Dam during the 1974 flood, and fits it into the computed discharge curve for Ashland Creek as a 30-year event. This methodology is inappropriate, since the regression equation is only applicable to an essentially unregulated watershed. Reeder Reservoir moderates all flood events, and is known to have substantially reduced the peak flow rate in the 1974 flood.

Montgomery indicated that the recurrence intervals of the 1964 and 1974 appeared to be from 20 to 50 years, based on the history of major floods for the Rogue River at Grants Pass, per Wilson and Hicks, 1975 (Montgomery, 1977). They further indicated that more detailed flow frequency data are not available. A more detailed explanation of their conclusion as to the frequency of these two floods is not given.

In order to determine the frequency-discharge relationships of Ashland Creek downstream from Reeder Reservoir it would be necessary to model reservoir inflow, available storage and resulting discharge through an adequate period of years with known data, including extreme events. No such modelling has been accomplished to date. This would be beyond the scope of this EIS and results would be of little benefit. However, it is evident that the response time between rainfall and peak runoff is less in the East and West Forks than in Ashland Creek below Reeder Reservoir due to the storage effects of the dam. Thus, a rainstorm with more sustained rainfall at a lower intensity than in 1974 might cause a greater discharge from Reeder Reservoir than 1,330 cfs while producing much lower peak flows on the East and West Forks. At present there is no factual basis for classifying the frequency of the 1974 discharge from Reeder Reservoir.

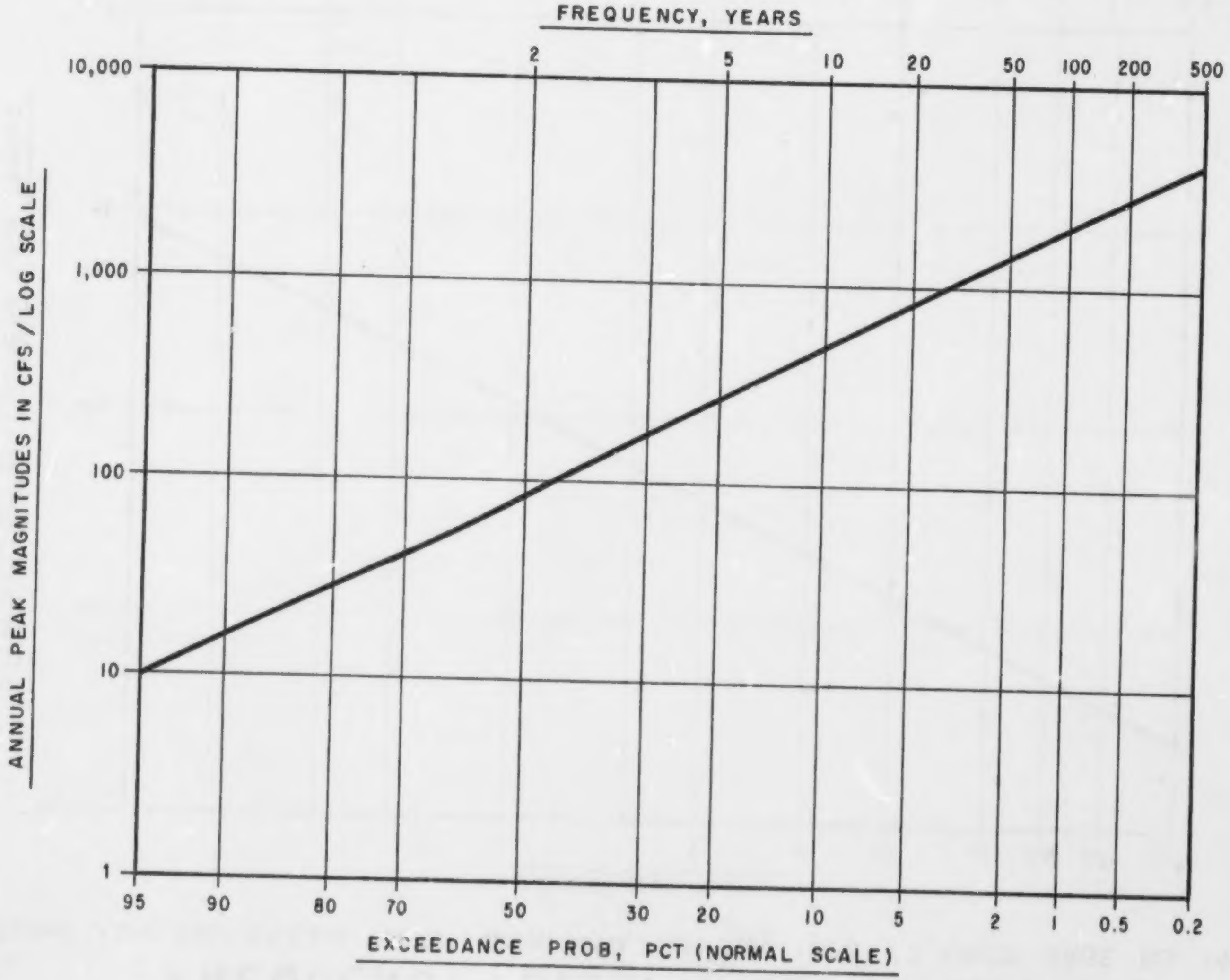
In an attempt to develop frequency-discharge relationship curves for Ashland Creek, the USGS Portland Office, on request of EPA's consultants, Jones & Stokes Associates, again prepared Log-Pearson Type III flood frequency analyses for the East and West Forks of Ashland Creek using the 20 years of peak flood flow data available at the time of this study. The results, Figures 2-10 and 2-11, show basically similar curves, with the East Fork having slightly higher discharges at given frequencies. The curves are essentially the same as those developed for the HUD study.

The plotted position of the 1974 flood peaks indicates a frequency range of once in about 800 years. Considering that this event was the most severe since disturbance of the watershed, and that runoff volumes were substantially

FIGURE 2-10

FREQUENCY - DISCHARGE ANALYSIS

EAST FORK ASHLAND CREEK NEAR ASHLAND, OREGON 1925-77 USGS GAGE NO. 14353500

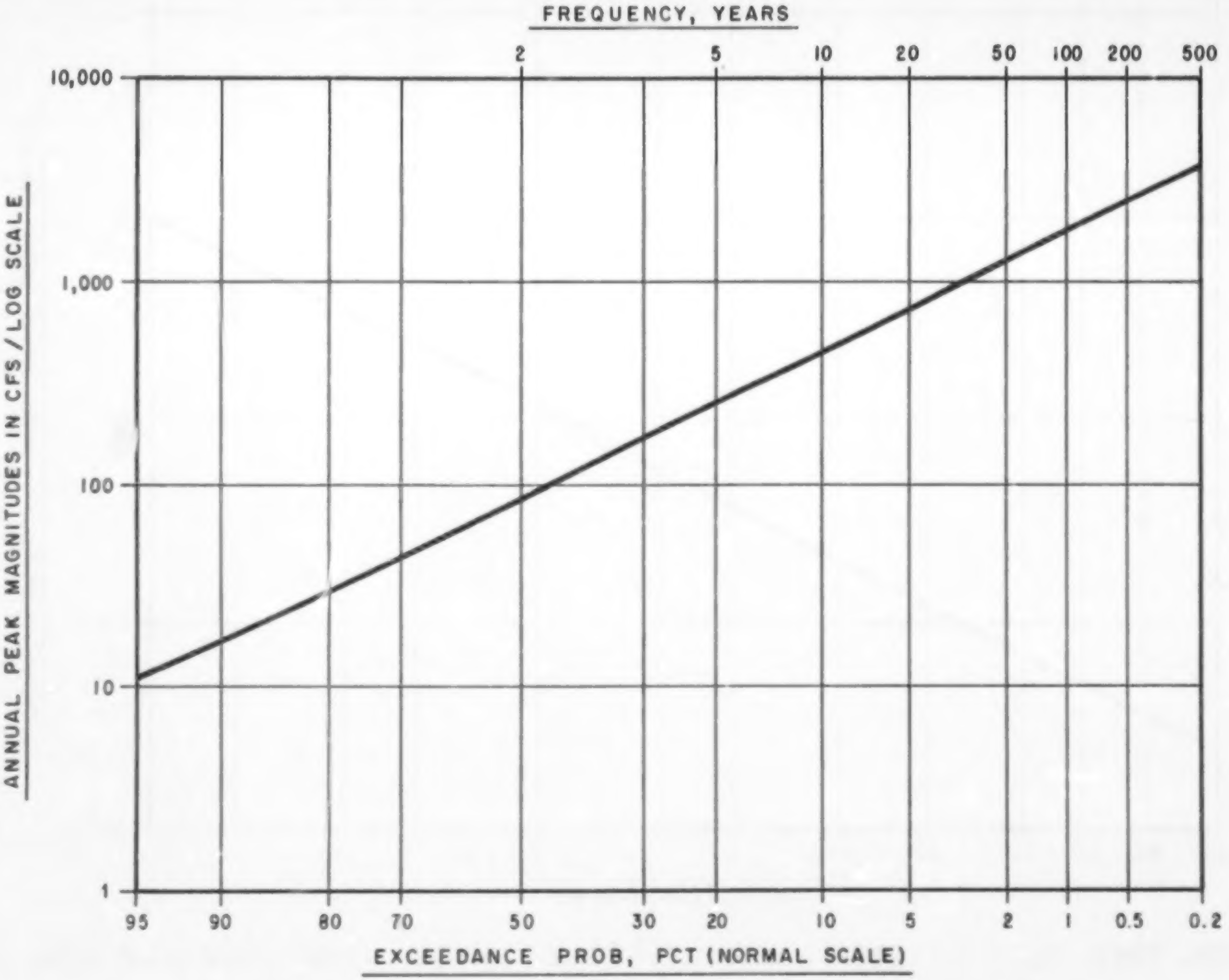


SOURCE: USGS, 1978

FIGURE 2-11

FREQUENCY - DISCHARGE ANALYSIS

WEST FORK ASHLAND CREEK NEAR ASHLAND, OREGON 1925-77 USGS GAGE NO. 14353000



SOURCE: USGS, 1978

JONES & STOKES ASSOCIATES, INC.

affected by debris, the 1974 event probably does not represent a once in 800 years recurrence of rainfall runoff. In general support of this, the city indicates that four relatively major floods have occurred since about the 1920s: One event in December 1947 and January 1948, one in December 1955, one in December 1964 and the January 1974 event. While the 1974 flood was the greatest the others were not significantly less (Fallon, pers. comm.). Only the 1974 flood volumes have been estimated.

If reliable frequency-discharge relationships could be compared to past records of flood peaks on Ashland Creek, it would be possible to develop better predictions of the probability of sediment inflows to Reeder Reservoir. However, the available stream gauge data cover relatively few years and omit most of the major flood events. Thus, the hydrologic information necessary to estimate a relationship between streamflow and sediment volumes is lacking.

Erosion and Sedimentation in the Ashland Watershed

The problem of sedimentation in Reeder Reservoir as a result of erosion in the watershed has been addressed by Montgomery (1977), the USFS (1974), Hicks (1975), Wilson and Hicks (1975), and others. The Montgomery study (1977) developed estimates of erosion in the watershed which correlate reasonably well with estimates of sediment quantities physically removed from Reeder Reservoir since the dam was completed in 1928. Being the most specific information available, it is used in this report as a basis for analysis.

Wilson and Hicks of the USFS (1975) prepared a study of the sources of sediment inflow to Reeder Reservoir. They concluded that the sources of most sediment in the watershed were natural, rather than man-caused. Their study encompassed the January 1974 flood. They estimated that 122,000 cubic yards of sediment were deposited in the reservoir by the flood, and from measurements of road failures and scarring, that 41,400 cubic yards were derived from these mass wasting sources. Their study points out that erosion is a continual process, and that eroded material is always present near and within the stream channels, awaiting the next flood with sufficient energy to move it. Thus, the remaining 88,600 cubic yards were assumed to have been in stream channel storage, having been eroded from largely natural sources in the 1960s and early 1970s. Originally, the study ascribed 95 percent of this 88,600 cubic yards to natural sources, and 5 percent to man-made sources. Hicks conducted further studies and, in 1977, revised his estimates to 70 percent natural, 30 percent man-made.

Montgomery (1977) reviewed and critiqued the Wilson and Hicks study, noting that surface erosion of the road surface was of major importance, but had not been accounted for. Montgomery further indicated their opinion that study of a one-year period might not be adequate to define sediment sources.

Montgomery proceeded to develop a methodology of modelling mass erosion and surface erosion on a year-by-year basis, relying substantially on work by Walter Megahan at the USFS Intermountain Range and Experiment Station in Idaho. Montgomery categorized sediment sources in such a way as to be able to assign rates to various sources. Their Table 5-4 and Figure 5-4 are reproduced to show the volumes they derived. They noted that the table and figure illustrate initial erosion of material, and do not represent its movement into Reeder Reservoir. Modelling of the movement of material was rejected as ". . . not possible with existing information."

The USFS took issue with the Montgomery methodology in a lengthy letter of comment on May 4, 1977. Among the many comments, the USFS indicated that Montgomery did not include the contribution of stream channels to the sediment volumes. The USFS comments were considered by Montgomery prior to publication of their final report in October 1977.

The actual sediment inflow to Reeder Reservoir was also estimated by Montgomery from a variety of sources. Table 5-2 from Montgomery (1977) illustrates the reported removals. Figure 5-2 (ibid) shows the rainfall events, watershed changes and sediment problems in context.

Several conclusions result from the prior studies and available data on the Ashland watershed.

- Peak sediment inflow to Reeder Reservoir accompanies peak flows
- The activities accompanying the initiation of multiple use management of the watershed in 1956 increased erosion and sediment inflow to Reeder Reservoir

In 1970, the USFS conducted a general functional inspection culminating in a moratorium on timber harvesting beginning that year. The USFS subsequently prepared several drafts of interim management plans, none of which have ever been adopted.

In 1973, the Oregon State Department of Environmental Quality recommended that:

> "Until the U. S. Forest Service prepares a water quality and quantity management plan for the Ashland Creek Drainage Basin to show that the City of Ashland water supply will be fully protected:
>
> a) That no further ski facilities be developed in the Ashland Creek watershed and that the planned expansion of present ski facilities be denied.

TABLE 5-4

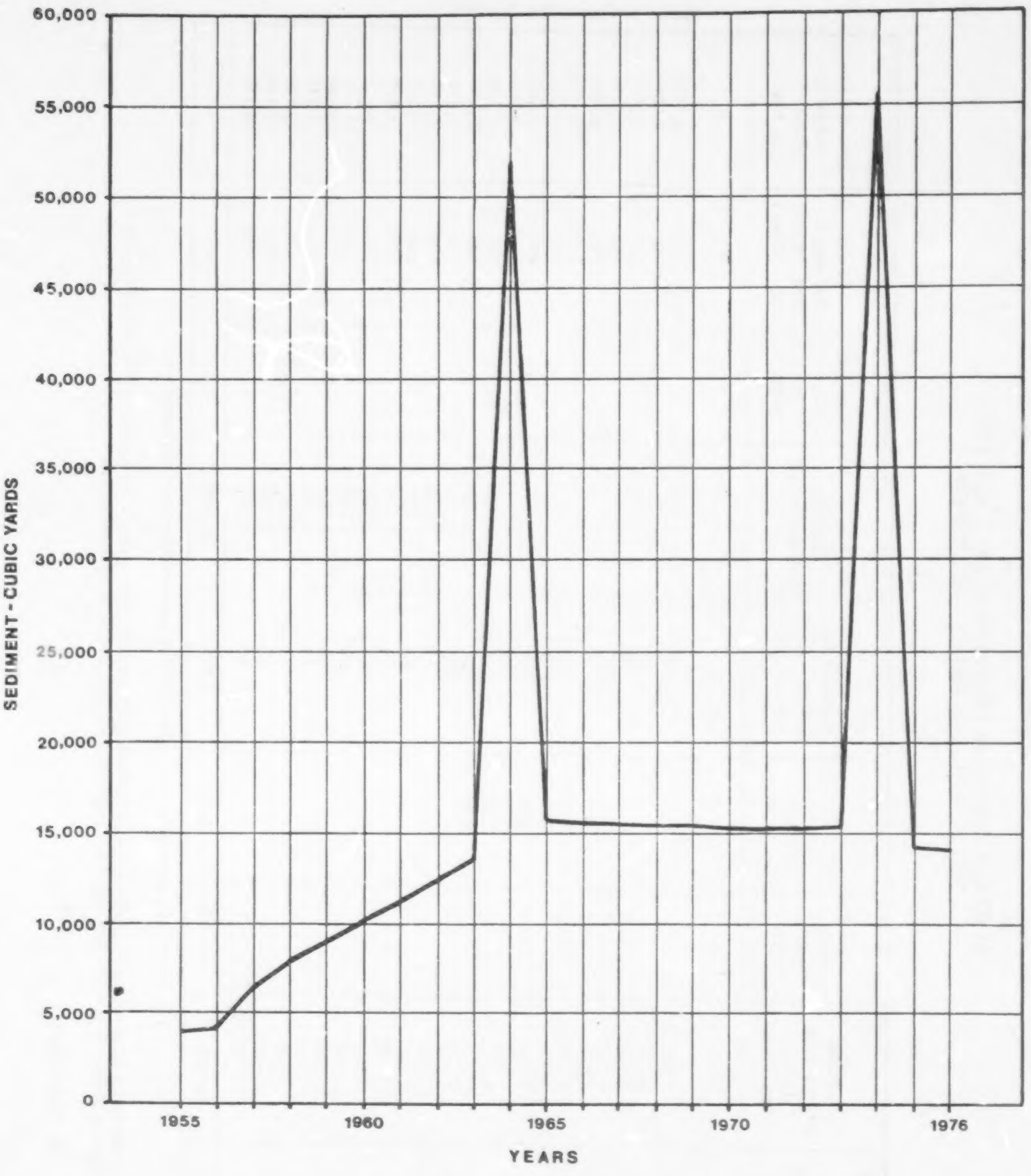
SURFACE AND MASS EROSION BALANCE FOR THE TOTAL ASHLAND CREEK WATERSHED

Year	Natural Watershed Erosion	Road Surface Erosion Base Load (due to O&M)	Road Prism Surface Erosion First Year	Road Prism Surface Erosion Second Year	Road cut/fill Surface Erosion Base Load	Ski Area Surface Erosion	Mass Soil Move-ment (USFS)	Timber Harvest S.E. 150 (10 yrs.) 400 (10 yrs.)	Total Surface and Mass Erosion* by Year
	1	2	3	4	5	6	7	8	9
1955	500	3,500			20				4,020
1956	500	3,500			20			60	4,080
1957	500	3,500	2,360		20			125	6,505
1958	500	4,600	2,360	200	20			190	7,870
1959	500	5,600	2,360	200	50			250	8,960
1960	500	6,700	2,360	200	70			310	10,140
1961	500	7,700	2,360	200	100			375	11,235
1962	500	8,800	2,360	200	120			440	12,420
1963	500	9,800	2,360	200	150			500	13,510
1964	500	10,900	2,360	200	170	7,100	30,000	560	51,790
1965	500	11,900		200	200	2,320		625	15,745
1966	500	11,900			220	2,320		610	15,550
1967	500	11,900			200	2,320		590	15,510
1968	500	11,900			180	2,320		580	15,480
1969	500	11,900			160	2,320		570	15,450
1970	500	11,900			140	2,320		550	15,410
1971	500	11,900			120	2,320		540	15,380
1972	500	11,900			100	2,320		520	15,340
1973	500	11,900			80	2,320		510	15,310
1974	500	11,900			60	1,200		490	55,550
1975	500	11,900			60	1,200	41,400	480	14,140
1976	500	11,900			60	1,200		470	14,130
	11,000	207,400	18,880	1,600	2,320	31,580	71,400	9,345	353,525

353,500 = Total material eroded 1955 - 1976 by surface and mass erosion processes.

* This column represents the total volume of material eroded through surface erosion and mass soil movement by year - however, it does not represent input to Reeder Reservoir - Routing of material is not possible with existing information.

SOURCE: Montgomery, 1977.



ESTIMATED ASHLAND WATERSHED SURFACE AND MASS EROSION YEARS 1955-1976

SOURCE: Montgomery, 1977.

FIGURE 5-4

TABLE 5-2

REEDER RESERVOIR
REPORTED SEDIMENT REMOVAL HISTORY

Years	Sediment Removed, cubic yards	Information Source
Before 1956	1200 cy/yr average from upstream debris basins	Shaw (1956)
1956 - 1963	No data - but increasing amount (say, 10,000 cy/yr)	City Staff (1977)
1966 - 1967	60,000 cy dredged from reservoir	Lund (1974) City Staff (1977)
1968 - 1972	Up to 20-30,000 cy by sluicing from reservoir (say 20,000 cy/yr avg)	DEQ (1973) City Staff (1977)
1973	70,000 by sluicing from reservoir	DEQ (1973) City Staff (1977)
1974	122,000 cy by truck and dredge	City Staff (1976) USFS (1976)
1975	5000-7000 cy by sluicing (say, 6000 cy)	City Staff (1976)
1976	68,000-78,000 cy by sluicing (say 70,000 cy)	City Staff (1976) Earth Sciences (1976)
1967 - 1976 TOTAL	428,000 cy	Rough estimate from above.
1956 - 1976 TOTAL	508,000 cy	Rough estimate from above.

SOURCE: Montgomery, 1977.

ASHLAND WATERSHED CHRONOLOGY OF EVENTS RELATED TO EROSION

Year	*Weather Conditions	Watershed Activity	Sediment Problems
1920 -	1928: Dam built; 850 ac ft reservoir (1.4×10^6cy)		
1930 -			
1940 -			
	12/47-1/48: heavy rain 8" total (USFS 1975)		
1950 -		1940-1956: 7 fires in watershed; minimal mancaused disturbance	Before 1956: annual sediment was about 1200 cy/yr in upstream basins, plus a relatively small amt. sluiced from main reservoir (Shaw, 1956; City staff, 1977)
1955 -	12/55: Flood, 11" rain in Dec-Jan (Shaw 1956, USFS 1975)		
		1956: Began construction of 40+ miles of road, which continued until 1960's. (USFS, 1977)	
		1958: began clear cut and partial cut logging (USFS, 1975)	
1960 -			
	12/62: 2" rain in Dec., after 7.2" in Oct, causes storm damage (USFS, 1975)	1963: completed most road construction; 37.3 miles, 270+ acres (USFS 1977)	1962: sediment inflow in Dec flood (USFS, 1975) 1963:
	12/64: big flood, with 7" rain in Dec, 3" on Dec 22 (USFS, 1975)	1964: open ski area; 183 acres	
1965 -		1965: most logging and thinning completed-1000 acres (USFS, 1975)	1964: big sediment inflow in Dec flood (City staff, 1976)
			1966-67: dredged 60,000+ cy (Lund, 1974; City staff, 1977)
	6/69: 2" rain storm (USFS, 1975)	1969: moratorium on logging and road construction (USFS), (1975)	1968-1972: sluiced 20,000-30,000 cy each year (DEQ, 1973)
1970 -			
			1973: sluiced 70,000 cy (DEQ, 1973)
	1/74: big storm; 10" rain in 2 days in Ashland (USFS, 1975)		1974: dredged and trucked 122,000 cy (City staff, 1976)
			1975: sluiced 5000-7000 cy (City staff, 1976)
			1976: sluiced 70,000 cy (City staff, 1976)

*Note: rainfall records are for Ashland

FIGURE 5-2

SOURCE: Montgomery, 1977.

b) That no further recreational developments be made in the Ashland Creek watershed.

c) That no more logging or road building be conducted in the Ashland Creek watershed.

d) That no mining be allowed in the Ashland watershed."

One of the proposed drafts of an interim plan was prepared by the USFS in 1973 following that DEQ recommendation. While never adopted, the draft plan does provide some insight as to the management measures being considered:

- No further road construction until existing roads, including Tolman Creek Road, are brought up to acceptable USFS standards
- Recreation, except for skiing, will not be encouraged, camping and off-road vehicles will be prohibited, but the ski area expansion will proceed unless "reliable information is developed that indicates such expansion will adversely affect Ashland's water supply."
- Grazing will not be authorized without city consent, and if fencing is needed to exclude livestock on adjacent lands from the watershed, the city will provide the fencing and the USFS will issue a use permit
- No wildlife habitat improvements will be undertaken, and hunting and fishing will be allowed, not encouraged
- The USFS will request that the watershed be withdrawn from mineral entry

Even in the absence of an approved interim plan, the USFS has taken steps to correct erosion problems by revegetation, slope stabilization, road maintenance, and retaining structures. Road fills subject to washout have in some cases been replaced by "storm resistant fords". Road drainage has been revised. Slopes have been stabilized by mulching, revegetation and armoring with rock. Retaining walls and log check dams have been constructed to intercept sediment. These measures appear to have reduced the risk of catastrophic erosion and sediment movement compared to the 1964 and 1974 floods.

In December 1979, the U. S. Forest Service and City of Ashland signed an interim plan for the Ashland watershed. This will be in effect until completion of a long-term plan to be part of the 1983 Forest Plan of the Rogue River National Forest. The interim plan, which has been approved by RVCOG, essentially continues the moratorium on timber harvest and road construction. The plan provides that no further expansion of the Ashland ski area will take place without a new EIS. Current road maintenance procedures will continue, and fuel breaks may be constructed at strategic locations.

As a result of improved management practices, erosion rates and sediment inflows to Reeder Reservoir are likely to decrease in the future, assuming no new or continued disturbances of watershed soils. The low pre-1956 erosion rates will probably never be attained again. And, even in those times, Reeder Reservoir had to be drained and sluiced to remove sediments from natural origins. Thus the cleaning of Reeder Reservoir will continue to be necessary if the city is to maintain the water supply function of the reservoir. However, the quantities of sediments that may be encountered are difficult to predict.

It is possible, however, to establish some likely ranges of future sediment inflows based on Montogomery's work. The estimated average annual sediment inflow to the reservoir prior to 1956 was estimated as about 1,200 cubic yards per year, prior to watershed disturbance. Based on the 1956-1976 period (21 years), 508,000 cubic yards of material were removed from Reeder Reservoir, or 24,190 cubic yards per year. This period included inflow from the 1964 and 1974 events, and is likely the upper limit. Using Montgomery's Figure 5-4, and assuming that future mass failures will be minimized by corrective measures, an annual erosion volume of 14,000 cubic yards per year, with gradual declines, could be postulated. However, it is important to note that while the 21-year erosion estimate of 353,000 cubic yards is reasonably close to the estimated material removal of 508,000 cubic yards during the same period, about 30 percent of the material removed is unaccounted for. Adjusting the 14,000 cubic yards per year to include this 30 percent would bring the average annual quantity to about 18,200 cubic yards per year, declining slowly. The sediment inflows would occur on an unpredictable basis, with the majority entering Reeder Reservoir during peak floods. It is likely that a single future flood could contribute a large percentage of these sediments in relatively few hours, and that sediment inflows at other times would be minimal. Thus, the application of "average" figures is misleading in that average events are unlikely to occur. However, for estimating costs and other evaluation purposes, it may be possible to assume average annual sediment inflows of 18,000 to 24,000 cubic yards per year with occasional one-year peaks below the nearly 200,000 cubic yards removed after the 1974 event, and some years of very little sediment inflow.

Analysis of Catastrophic Sediment Inflows

The City of Ashland has historically been faced with two categories of operations relative to cleaning Reeder Reservoir: normal and catastrophic. The annual draining and sluicing that routinely occurred through 1963 could certainly be termed "normal". The 1964 and 1974 floods, which blocked the sluiceway outlet and prevented draining and sluicing until a significant amount of dredging could be completed, can be considered catastrophic. Indeed, the 1974 flood brought sediment up to the bottom of the water supply outlet in Hosler Dam. Had the sediment been deeper, it could have blocked the intake or damaged facilities at the treatment plant, forced the closure of the pipeline, and left the city without a potable water supply for several days or weeks. (The plant was closed briefly by flows in Ashland Creek in the 1974 flood.)

Any event which would close both the sluiceway outlet and the water supply outlet is decidedly catastrophic. Any event which closes the sluiceway outlet could force the city to undertake special operations to reopen it, such as occurred in 1964 and 1974. Such events will also be considered as catastrophic for purposes of analysis in this document.

Normal reservoir cleaning operations can be accomplished at times and by methods corresponding to the individual alternatives selected for analysis in this EIS. But cleaning operations following catastrophic events may not be possible within the methods and time constraints embodied in the alternatives. For instance, in 1974, dredging operations continued into the irrigation season, and the sluiceway opening still remained plugged until 1976, except briefly in 1975 during attempts to sluice.

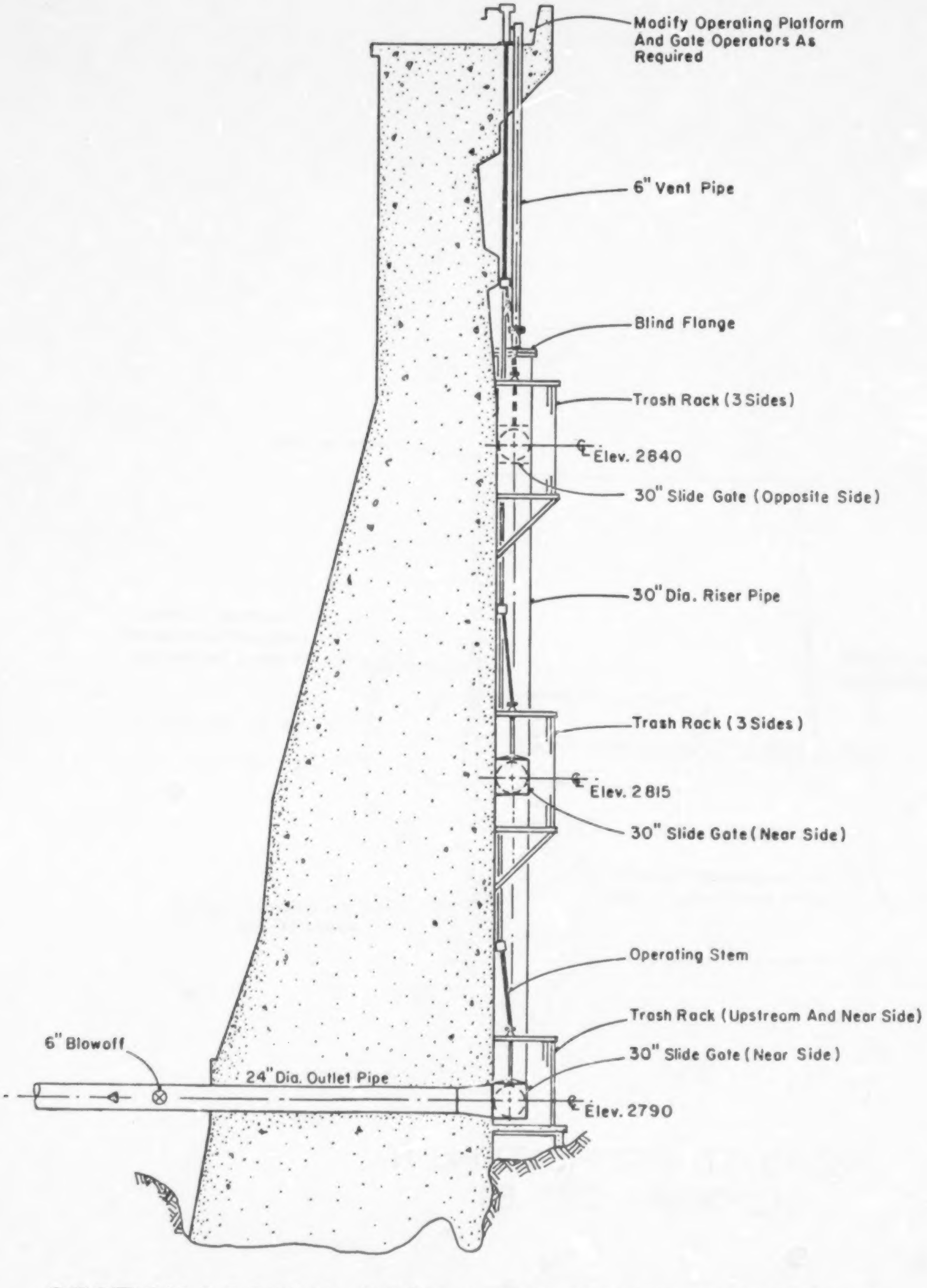
The question next arises as to whether each alternative should be evaluated as to its suitability for use following catastrophic events, and as to its downstream impacts resulting from reservoir cleaning under such conditions.

One solution to this question lies in the recommendations of the Montgomery report (1977). In that document it is recommended that the sluiceway outlet and the water supply outlet both be modified to protect against blockage and to provide added flexibility in drawing reservoir water for treatment. If the water supply outlet were to be modified with additional intakes at higher elevations against the dam face and each be protected by trash racks, it is unlikely that the most catastrophic situation of blockage of the water supply intake could ever occur.

If the sluiceway outlet were to be enlarged to 48" in diameter from its present 24" diameter as recommended, and a trash rack capable of mechanical or hydraulic cleaning is installed, the sluiceway should be much easier to open, even following a 1974-type event.

The improvements proposed by Montgomery, shown in their Figures 6-2 and 6-3, are included herein. The costs of the improvements are indicated by Montgomery to cost from $75,000 to $100,000 for additional water supply intakes, and about $100,000 for sluiceway outlet modifications. The feasibility study to determine whether the sluiceway outlet can be safely modified might cost $10,000 to $20,000. The above costs are in 1977 dollars.

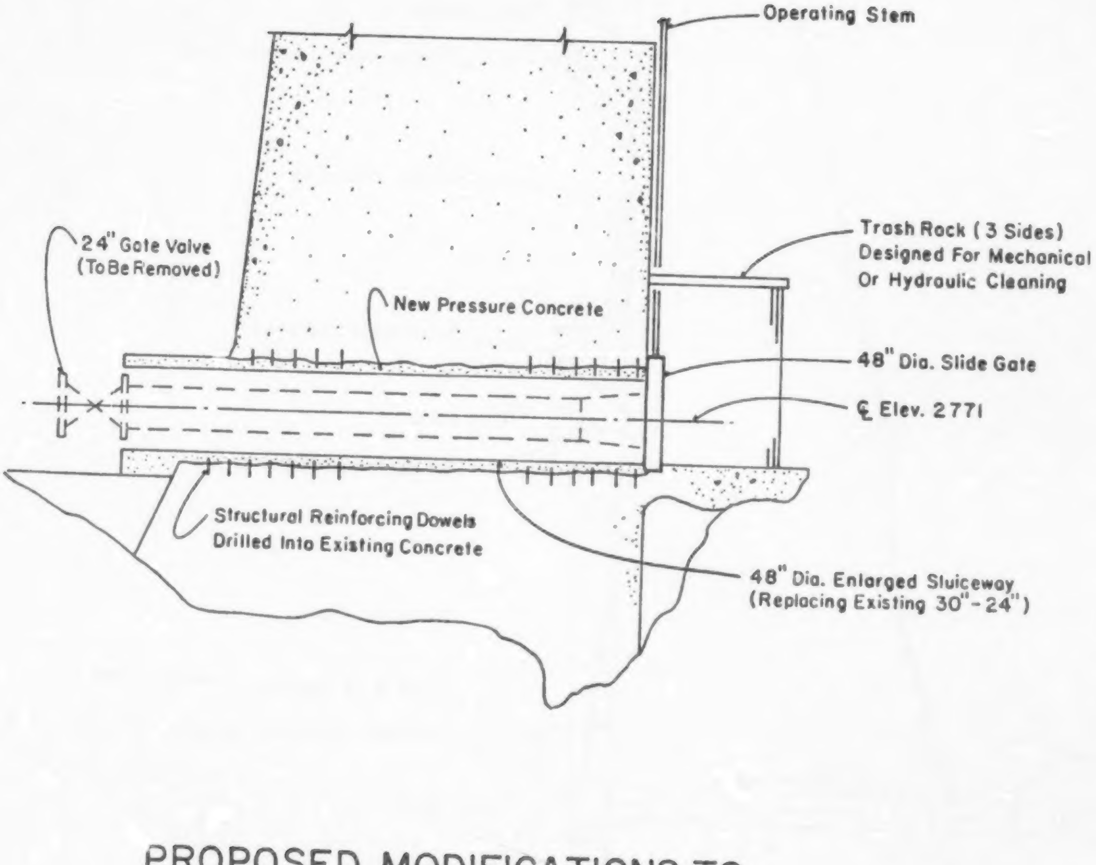
With these two improvements implemented, a catastrophic event becomes much less likely. However, at present the city has no definite plans to implement these recommendations. Therefore, this document will include the impact of extraordinary cleaning operations, using available data from the cleaning operations following the 1974 flood as the primary basis of analysis.


Modify Operating Platform And Gate Operators As Required
6" Vent Pipe
Blind Flange
Trash Rack (3 Sides)
℄ Elev. 2840
30" Slide Gate (Opposite Side)
30" Dia. Riser Pipe
Trash Rack (3 Sides)
℄ Elev. 2815
30" Slide Gate (Near Side)
Operating Stem
Trash Rack (Upstream And Near Side)
30" Slide Gate (Near Side)
℄ Elev. 2790
6" Blowoff
24" Dia. Outlet Pipe

SECTION LOOKING EAST AT SERVICE OUTLET
PROPOSED ADDITIONAL SERVICE OUTLETS

SOURCE: Montgomery, 1977.

Figure 6-2


Operating Stem
Trash Rack (3 Sides) Designed For Mechanical Or Hydraulic Cleaning
24" Gate Valve (To Be Removed)
New Pressure Concrete
48" Dia. Slide Gate
℄ Elev. 2771
Structural Reinforcing Dowels Drilled Into Existing Concrete
48" Dia. Enlarged Sluiceway (Replacing Existing 30"-24")

PROPOSED MODIFICATIONS TO SLUICEWAY OUTLET

SOURCE: Montgomery, 1977.

Figure 6-3

Chapter 3

ALTERNATIVES

Several alternative ways to remove sediments from Reeder Reservoir have been identified. Each satisfies the objective of removing accumulated sediments from the reservoir, or preventing their accumulation. The first set of alternatives examined would pass the sediments through the reservoir into Ashland Creek below the dam at various rates and times. These alternatives reflect the current practices of the city of draining and sluicing the reservoir in early spring; the recommendation of Montgomery Engineers that the city cease draining and sluicing, converting to dredging; reverting to pre-1940s practice of draining and cleaning the reservoir in the fall; and draining the reservoir for the entire rainy season, along with a supplemental water supply, to enable the city to maintain adequate water service.

A second set of alternatives is also addressed. These alternatives are options evaluated and rejected by Montgomery Engineers. They are not considered viable by EPA at this time. Two of these involve removal of sediments from the Bear Creek system, one requires permanent allocation of sediment storage in Reeder Reservoir, and one consists of a bypass around the reservoir for sediment-laden flows.

Each of these alternatives is discussed in some detail in this section. Costs are presented for the four viable alternatives. A 20-year cost evaluation period is used since this would be about the estimated useful life of a dredge.

Alternative 1 - Spring Draining and Sluicing

The City of Ashland could continue to drain and sluice Reeder Reservoir, following the practice begun in 1929, soon after the dam was constructed. Since the 1940s this draining and cleaning has taken place in the spring to minimize conflicts with water supply requirements. This practice involves draining the reservoir completely every few years, sluicing sediments through the outlet at the bottom of the dam, and allowing stream flow to carry the sediments downstream.

When a decision to drain and sluice is made, based on information that sediment is present and that the snowpack in the watershed is adequate to refill the reservoir when it melts later in the spring, the reservoir is drained over a 4- to 5-week period. The reservoir bottom is then sluiced with pressure hoses on a round-the-clock basis for 2 to 4 weeks to remove sediment. The outlet is then closed, and the reservoir is allowed to refill from spring runoff.

As part of this alternative, the water supply intake at the dam would be modified as recommended by Montgomery to allow intake at several elevations in the reservoir, and the sluiceway outlet would be enlarged and trash racks improved, also as recommended by Montgomery.

The cost of Alternative 1 is estimated as follows, based on data from Montgomery (1977) and the City of Ashland (1976). The cost of the feasibility study was assumed at 15 percent of construction cost.

Sluiceway outlet modification study	$ 15,000
Modification of sluiceway outlet	100,000
Modifications of water supply intakes	100,000
Sluicing[1]	99,600
Total equivalent capital cost	$314,600

[1] Present value at 7 percent interest of sluicing 24,000 cubic yards per year for 20 years.

Alternative 2 - Dredging During High Stream Flow

The City of Ashland could purchase a floating dredge which would remain in Reeder Reservoir, and be operated to clean the reservoir during periods of high runoff. The dredge would discharge a sediment-water slurry to Ashland Creek just downstream of the dam. This option was recommended by Montgomery (1977) as the preferred choice for the city.

It should be noted that dredging is not 100 percent efficient in removing sediments in the bottom of the reservoir since they are not readily visible, but can only be detected by survey. Thus, dredging probably will not preclude the continuing need to drain and sluice the reservoir, although this would become less frequent. Future floods are likely to result in debris accumulation, preventing dredging in those areas where stumps, logs and boulders become concentrated. The city staff believes draining for inspection, debris removal and sluicing of those sediments not reached by the dredge would initially be required after 3 to 4 years. Repeat drainings would be required in future years, with the interval depending on debris and sediment volumes, which are functions of flood flows, and depending on the success of the dredging. Draining and sluicing would take place as described in Alternative 1.

Modification of water supply intakes and enlargement of the sluicing outlet would also be implemented as recommended by Montgomery.

The cost of Alternative 2 is estimated based on data from Montgomery (1977), the City of Ashland, and an assumed study cost of 15 percent of construction costs. The division of costs between dredging and sluicing is based on an assumed 75 percent effectiveness of dredging, with the remaining 25 percent being removed by sluicing.

Sluiceway outlet modification study	$ 15,000
Modification of sluiceway outlet	100,000
Modification of water supply intakes	100,000
Dredge purchase	350,000
Dredging[1]	63,600
Sluicing[2]	24,900
Total equivalent capital cost	$653,500

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[1] Present value at 7 percent interest of dredging for 20 years, based on $6,000 per year operating and maintenance costs, per Montgomery, 1977.

[2] Present value at 7 percent interest of sluicing 6,000 cubic yards per year (average) for 20 years.

Alternative 3 - Fall Draining and Sluicing

The City of Ashland could continue to drain and sluice Reeder Reservoir, but could do so in the fall after November 15 rather than spring, reverting to the practice followed prior to the late 1940s. This timing would result in the discharge of sediments to the Bear Creek system prior to the winter rains, providing a better opportunity for them to be washed on through the Rogue River and into the ocean by high streamflow.

The cost of Alternative 3 is the same as for Alternative 1 and is repeated as follows:

Sluiceway outlet modification study	$ 15,000
Modification of sluiceway outlet	100,000
Modification of water supply intakes	100,000
Sluicing[1]	99,600
Total equivalent capital cost	$314,600

[1] Present value at 7 percent interest of sluicing 24,000 cubic yards per year for 20 years.

Alternative 4 - Drain Reservoir for Entire Rainy Season

Recognizing that Reeder Reservoir does not generate sediments, but merely traps sediments that flow into it, one approach could involve returning the timing of sediment flows to a more natural condition. This would consist of draining Reeder Reservoir each fall, leaving it empty until near the start of the irrigation season. Any flood flows or freshets during this period would pass through the reservoir and, with their sediments, maintain a more natural timing of sediment loads.

However, this option would leave the city without fall and winter storage for water supply, virtually ensuring shortages in water supply during low flow periods and freezes, both of which are quite common.

This option would only be practical if some supplemental water becomes available to Ashland during fall, winter and early spring. For purposes of evaluation, it is assumed that a new water supply reservoir would be constructed within the Ashland watershed, at the Winburn Site on the West Fork of Ashland Creek, as evaluated by Montgomery Engineers. Construction of this new dam was recommended by Montgomery (1977) as part of a program to meet the increasing water demands of the city. (It should be pointed out that this EIS is not intended to evaluate the construction and operation of this reservoir, but only to evaluate this alternative operational scheme of Reeder Reservoir with Winburn Reservoir in place.)

Under this alternative, Ashland would drain Reeder Reservoir each fall following the irrigation season, probably in conjunction with the first fall rains. As storms brought sediments into Reeder Reservoir the stream flow would theoretically flush it on through into Bear Creek as if no reservoir were present. In reality, the reservoir would provide some flood attenuation, and the sluiceway outlet might be susceptible to clogging by debris. Modification of the outlet as recommended by Montgomery and the presence of Winburn Dam should largely alleviate this problem.

The cost of Alternative 4 is estimated from data by Montgomery (1977) as follows:

Winburn Dam, including pipeline to West Fork Diversion Dam	$4,590,000[1]
Sluiceway outlet modification study	15,000
Modification of sluiceway outlet of Reeder Reservoir	100,000
Modification of water supply intakes in Reeder Reservoir	100,000
Total	$4,805,000

[1] City anticipates 50 percent grant for Winburn Dam, reducing city share to $2,025,000, and total cost of alternative to $2,240,000.

Previously Evaluated Alternatives

In addition to the foregoing alternatives Montgomery Engineers evaluated several other options, discarding them in favor of a recommendation of dredge with discharge into Ashland Creek just downstream from Reeder Reservoir. Neither EPA, DEQ, RVCOG nor the City of Ashland consider these alternatives to be viable. Each of these alternatives is presented and discussed below. The discussion from the Montgomery report is quoted in its entirety, followed by further discussion and evaluation.

Debris Basins

> "The use of upstream basins which would act as settling ponds to accumulate sediment requires construction of dams at sites with substantial storage capacity and provisions for removal of the accumulated solids. Such sites were found to be very limited in the Ashland Creek watershed. Due to the limited access in the area and the lack of an appropriate site, there is no advantage for installation of debris basins separate from Reeder Reservoir" (Montgomery, 1977).

It is probable that acceptable sites for debris basins could be located on the East and West Forks of Ashland Creek. For instance, the two diversion dams just upstream from

Reeder Reservoir act as limited debris basins now, although suspended sediments and floating debris pass through without settling. During the 1974 floods, the diversion dams were filled and surcharged by boulders, gravel, sediment and debris. These accumulations were subsequently removed from the watershed tributary to the dam at considerable expense.

The amount of storage that would be required for sediment and debris is substantial. Peak events could contribute over 100,000 cubic yards. The 1974 flood contributed an estimated 170,000 cubic yards. To handle a peak event roughly equivalent to the 1974 flood, debris basins with at least 10 percent of the storage volume of Reeder Reservoir would be needed. These would have to be cleaned each year by clamshell dredge, dragline or conventional excavation methods. (Obviously, sluicing it downstream would only transfer the problem to Reeder Reservoir and be self-defeating.) Excavation from debris basins may be less costly than excavating in Reeder Reservoir and also would preclude having to drain the reservoir.

The cost of removing, hauling and disposing of such sediments, either in debris basins or Reeder Reservoir, would be quite expensive. For instance, excavation following the 1974 floods, with no significant hauling and no disposal, cost Ashland about $5.50 per cubic yard. This compares with costs less than $.40 per cubic yard for sluicing in 1976. Adequate disposal locations would also have to be found, or acceptable uses developed to preclude materials ending up back in Ashland or Bear Creek, if this is the objective to be met by this alternative.

In conclusion, the option of debris basins would only be desirable if it is found necessary to remove the sediments from the Ashland-Bear Creek system, if it were more cost-effective to mechanically remove and haul sediments from debris basins than from Reeder Reservoir, and if suitable sites could be located.

This option was apparently rejected by Montgomery due to the lack of a defined need to remove sediments from the creek system, and due to relatively high cost.

Allocation of Sediment Storage Space

> "Storage in the Ashland Creek system is needed for seasonal regulation of the creek flows and to meet the city's water demands. Higher dams and larger reservoirs to permit allocation of storage space for permanent sediment accumulation, similar to that designed for water storage, were evaluated but found to be impracticable given the physical limitation of the available sites" (Montgomery, 1977).

Using Montgomery's estimates of sediment removal from the reservoir as being about equal to sediment inflow, it is possible to estimate how long Reeder Reservoir could provide sediment storage space. First, however, it must be pointed out that each unit volume of sediment stored in the reservoir replaces an equivalent unit volume of water storage. Further, at the time the sediments rise above the service outlet (which is only 20 feet above the reservoir floor), the water storage usability of Reeder Reservoir is immediately and totally lost. If the Montgomery recommendations to provide service outlets at several higher elevations were implemented, this sudden loss of water storage could be postponed.

The total volume of Reeder Reservoir is estimated at 790 acre-feet at the elevation of the spillway crest. This is a volume of about 1,275,000 cubic yards. Based on average annual sediment inflow of about 18,000 to 24,000 cubic yards per year, Reeder Reservoir would be totally filled level with the dam in about 53 to 70 years. The reservoir would lose its water storage benefits many years prior to these estimated times.

Of course, if management techniques in the watershed reduce sediment yields, then these estimated times would be longer. Also, variations in hydrologic patterns and the occurrence of extreme events could significantly alter these estimates. For instance, the 1974 storm was estimated to have caused an 800-year frequency flood (USGS, 1978) and this single event yielded sediment equivalent to about 13 percent of the storage volume of Reeder Reservoir. It is not inconceivable that another severe flood could, in one several-day period, use a noticeable portion of the Reeder Reservoir volume.

Further, once the reservoir has filled with sediments, new inflows will then pass through the reservoir and on downstream into Ashland and Bear Creeks as if no reservoir were present at all.

This alternative essentially implies abandonment of Reeder Reservoir as a water storage-water supply facility at some time during the next few decades, with continued reduction in water storage in the interim. It was rejected as an unacceptable alternative. Construction of new reservoirs with allocation of sediment storage volume likewise does not appear to be a reasonable option, given the relatively rapid sediment movement now occurring, and the high cost of dam construction.

Stream Flow Bypass

> "The largest sediment volumes are produced during flood flows. Therefore, in order to bypass the sediment around Reeder Reservoir the capacity of the bypass would have to be equal to such flood flows. A canal or pipeline with the capability to handle peak runoff during floods would need to be over 12 feet in diameter and about 3/4 mile long, with major diversion works on both forks of Ashland Creek. Regardless of the physical and economic feasibility of the bypass, the concept would entail the loss of much of the water needed to fill the reservoir for summer storage, making this alternative impracticable" (Montgomery, 1977).

This alternative requires that flood flows be removed from the East and West Forks of the creek when maximum runoff occurs, and that about 2/3 mile of conduit, sized for the largest floods, be constructed alongside or within Reeder Reservoir. The construction of the conduit or canal would probably exceed $1,000,000 and be very difficult to operate and maintain once completed. The physical and economic feasibility are indeed questionable.

While this alternative would pass sediments on through the reservoir area as if there were no dam, its high cost and feasibility problems appear ample cause for rejection.

Downstream Settling Basins

> "Downstream settling basins were evaluated relative to containing the dredged volumes of sediment from Reeder Reservoir. Preliminary consideration also was given to diverting the flow of Ashland Creek during normal sluicing operations, but was considered not to be feasible, as the reservoir can no longer be emptied from a water resource standpoint. Consequently, consideration was only given to containing the dredged volumes in settling basins.
>
> "The dredge has the capacity to discharge 1,000 cy of sediment a day over a 16-hour period. This would equate to 40,000 to 120,000 gallons of dredged slurry per day, depending upon the efficiency of the dredging operation. Table 6-2 shows the potential slurry volumes for various sediment accumulation, assuming 10 percent solids and 90 percent water.

Table 6-2

POTENTIAL SLURRY VOLUMES FROM DREDGING

Sediment Accumulations	Slurry Volumes
3,000 cubic yards	240,000 gallons
10,000 cubic yards	800,000 gallons
50,000 cubic yards	4,000,000 gallons

"The slurry would have to be conveyed in a pipeline or in Ashland Creek to some point where it could be put into a settling basin and dried. Following drying, it would have to be removed for land disposal or possible reuse.

"The size of the settling basin to contain 4,000,000 gallons of water would be approximately 514,000 cubic feet; the solids would be 51,400 cubic feet. Since the settling pond would collect rainfall at approximately 20 inches per year, you could not have more than 1 cubic foot of slurry per square foot of space and still achieve drying through evaporation. Consequently, the size of the settling pond for 50,000 cubic yards of sediment removal would be over 12 acres. It would also be necessary to have additional capacity for higher than average rainfall years or potential for larger volumes of sediment. Consequently, a settling basin(s) of approximately 15 to 18 acres would be required. Total land acquisition would require approximately 20 to 25 acres, depending on the site conditions. The basic problem with this alternative is the accuracy of the numbers developed, because the solids to slurry percentage could vary widely from our estimate of 10 percent, and the volumes of sediment to be removed are estimates based upon only a few actual measurements.

"No potential sites exist for settling basins from Reeder Reservoir to Lithia Park or in the immediate vicinity of Ashland. The social and environmental problems associated with siting settling basins in the Ashland area would be major.

"Consequently, it is recommended that until considerably more information exists on the actual dredge solids percentage and accurate data of annual sediment accumulations, this alternative cannot be evaluated. It is felt that a minimum of 10 years of reliable data be available on the annual sediment accumulation following the proposed watershed management plan" (Montgomery, 1977).

Variations of the downstream settling basins are possible, whereby a slurry pipeline could be constructed from Reeder Reservoir to lands near Bear Creek north of Ashland, and ponds constructed in this area. The design of a slurry pipeline able to withstand the abrasion of the sediments would be a challenge and, if blocked, removing the jam would be difficult or perhaps impossible.

If this approach could be made practical and pond sites located and financed, the ponds could discharge to Ashland Creek or Bear Creek after settling some predetermined percentage of solids, for instance 90 percent. Accumulated rainwater could likewise be discharged. The discharges would be regulated by a new DEQ permit. Ponds smaller than those assumed by Montgomery could then be used, and the material could be dried in piles adjacent to the ponds and used as a source of fill or construction material, depending on its nature.

If it is deemed necessary to remove the sediments from Ashland and Bear Creeks, this option might bear further consideration.

Chapter 4

ENVIRONMENTAL IMPACTS OF VIABLE ALTERNATIVES

This section of the EIS identifies and evaluates the changes or impacts that result from cleaning Reeder Reservoir. Four alternatives that would discharge the sediments into Ashland Creek immediately downstream from the dam are considered viable and are evaluated as to their effects. These viable alternatives are:

- Spring draining and sluicing
- Dredging during high stream flow
- Fall draining and sluicing
- Drain reservoir for entire rainy season

In addition, the effects of cleaning following catastrophic sediment inflow are presented.

It should be kept in mind that without Reeder Reservoir the same quantity of sediments would be tributary to Bear Creek, since they originate from man-induced disturbances and from natural sources within the watershed. The dam impounds these sediments, and the cleaning operation then releases them into the stream in unnatural concentrations relative to stream flow. Therefore, the impact evaluation emphasizes the timing-related variations between alternatives, as well as the absolute impact of the sediments being contributed to the Ashland Creek-Bear Creek system.

Mitigation measures to lessen or eliminate adverse impacts are also presented where appropriate. Some mitigation measures are costly, impractical under present situations, or beyond the control of the city. These are noted at appropriate locations.

Impacts Common to all Alternative Plans

Certain impacts are common to all of the alternatives, and are addressed at this point to avoid redundancy. These include the effects of modifying the water supply intake structure and the sluiceway outlet.

- Construction impacts of modifying the water supply intake on Ashland water supply

The Montgomery study (1977) recommends additional water supply intakes in the dam to enable water to be withdrawn from the reservoir at additional levels for water supply purposes. The reservoir would have to be drawn down for installation of the new riser pipes, trash racks and inlet gates. At most times release of virtually all of the stored water in Reeder Reservoir to make the necessary modifications would have an adverse effect on the amount of water available to the city for water supply purposes. If the reservoir were drained in the late spring, summer or fall, it would most probably not regain sufficient stored water to supplement low summer stream flow, or to supplement low stream flow during freezes. Without being able to draw on stored Reeder Reservoir water, the city's sole supply would be stream flow, which can drop to less than half of the city's water demands.

This adverse impact can be mitigated by selecting a relatively wet spring to drain the reservoir, and construct the water supply intake modifications. This is consistent with the current practice of evaluating the snowpack prior to draining for reservoir cleaning. In such years the runoff from snowmelt later in the year can be depended upon to refill the reservoir by early summer, preventing any shortfalls in water supply.

The modification of water supply intakes, and the accompanying draining of the reservoir, will require the city to use the intakes at the East and West Fork Diversion Dams for water supply until the reservoir has again filled above the supply intake of the dam. This situation is typical of times when the city cleans Reeder Reservoir, although it may result in some turbidity in the raw water supply to the treatment plant during freshets in the streams. The water treatment plant is capable of adequate filtration to provide safe and high quality water for the domestic water supply even with turbidity, although filters must be cleaned more frequently.

Other construction impacts include augmented stream flow on Ashland Creek below the dam while the reservoir is being drained, about 15 cfs greater than the stream flow would normally be, and lasting for about 4 weeks; increased traffic on the unpaved road to the work site, with some minor dust and air pollutant generation; and some exposure of construction workers to the safety hazards of working high on the dam, an impact that can be mitigated by adequate safety precautions.

- Operational impacts with modified water supply intake

If the water supply intake is modified as recommended by Montgomery, the city will have reduced turbidity in its raw water supply. This would reduce loads on the filters at the treatment plant, allowing longer filter runs between cleaning, reducing the cost of water treatment, and reducing expenditures for treatment chemicals. This benefit would accrue by virtue of the city being able to take water from three different levels, as compared to only one level at present. Turbid waters entering the reservoir often stratify by density, a function of temperature and turbidity. The city could select the least turbid level to supply raw water to the treatment plant. The option of drawing from the upstream diversion dams would also remain.

Under catastrophic sediment inflow conditions such as those in 1964 and 1974 the water supply intake has been in danger of blockage. In 1974 sediment was deposited right to the bottom of the intake. If additional intakes are provided at higher levels, the threat of blockage would be removed (unless the lowest intake were left open throughout a major storm). With proper operation, this modification would provide a significant protection to the city's water supply, and would greatly reduce the urgency of immediate sediment removal following a major flood. The timing of eventual sediment removal could then be scheduled on a nonemergency basis to minimize downstream impacts. Such a modification would be a significant step toward eliminating the threat of "catastrophic" occurrences threatening the city's water supply.

- Construction impacts of modifying the sluiceway outlet from Reeder Reservoir

The Montgomery study (1977) also recommends enlarging the sluiceway outlet at the bottom of Hosler Dam and modifying the trash racks to permit hydraulic or mechanical cleaning from the top of the dam. In order to accomplish such a modification, the dam must first be evaluated to be certain that it can be modifed. A detailed structural analysis and a dam safety inspection would be needed to determine whether this is physically and economically feasible (Montgomery, 1977).

The modifications would involve physical removal of part of the concrete around the present sluiceway outlet, enlarging the opening to perhaps 6 feet in diameter. Steel dowels would be drilled into the existing structure. A pipe liner would be placed through the center of the enlarged opening, and the space between the dam structure and the liner filled under pressure with high-strength concrete. Trash racks and operating hardware would be installed, and then the reservoir could be refilled.

The complexity and difficulty of construction would probably require several months. The reservoir would first have to be drained and cleaned, and then all stream flow diverted from the sluiceway outlet. Such a diversion could be accomplished by constructing a small coffer dam in the reservoir and pumping intercepted flows over the dam or through the water supply intake, discharging to Ashland Creek upstream from the water treatment plant. This would probably need to be done during the summer to reduce the chance of a flood overtopping the coffer dam and damaging the construction work.

By performing the construction in the summer, and with Reeder Reservoir empty, the city would be required to depend totally on stream flow in the East and West Forks of Ashland Creek throughout the construction period, and probably until the following spring. Since stream flow is often less than water demands, water use by city residents would have to be cut back until stream flow increased and Reeder Reservoir refilled.

This inability of the City of Ashland to rely solely on stream flow to meet water supply needs is graphically illustrated in Figure 4-1. The curved line shows the median July stream flow for both forks, and the horizontal lines show water demands for the peak day (highest one-day demand of the year) and the average July day (July is the month of highest demand). Figure 4-1 shows that the city would only have about a 44 percent chance of meeting peak day water demand from stream flow, and only a 57 percent chance of meeting average July day water demand from stream flow.

There is at least a 10 percent chance that the amount of water actually available on a July day would be less than half of the normal daily demand.

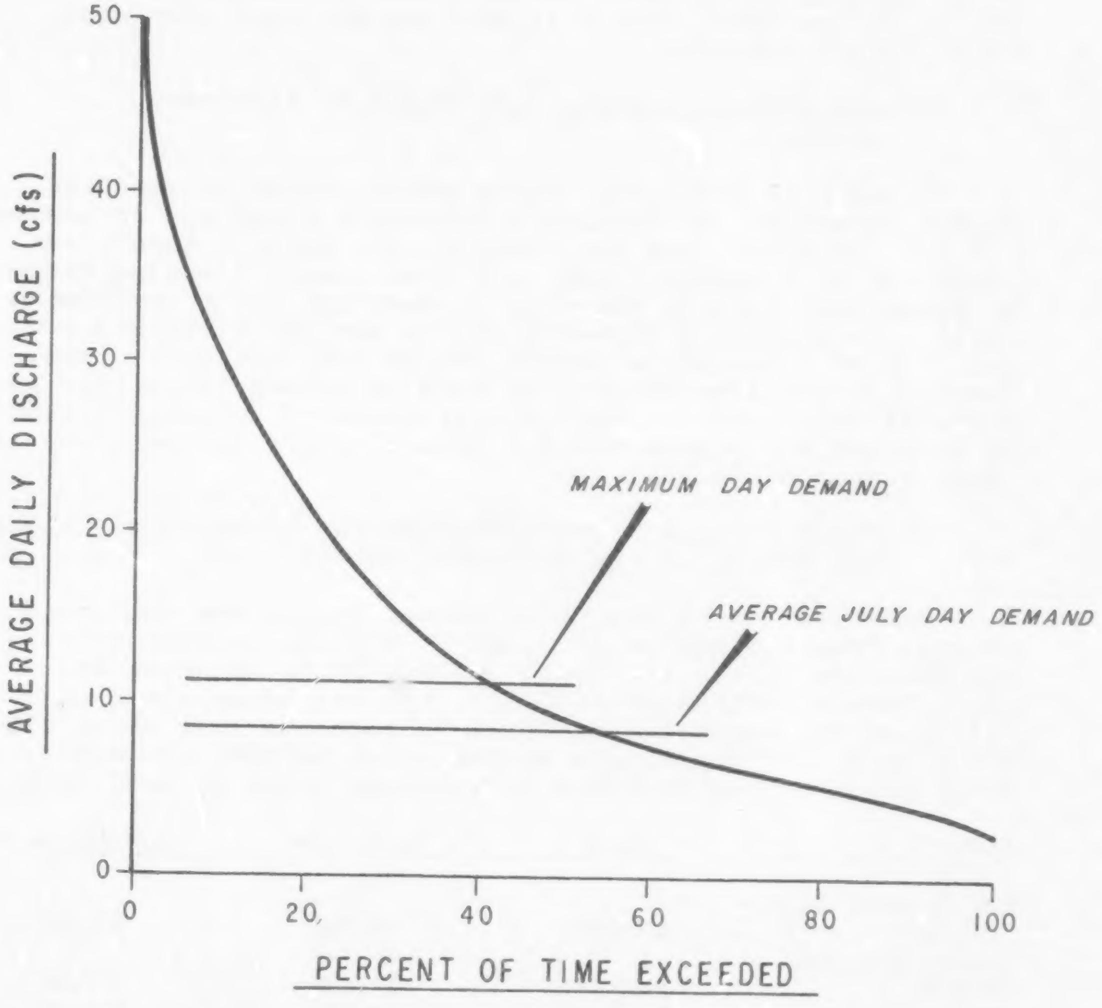
To the extent that stream flow falls short of demand, usage must be decreased. If it is not, the system would physically run out of water at higher elevations in the city, preventing fire-fighters from extinguishing fires, and possibly damaging and contaminating the water supply pipelines. A public health hazard would result.

The city could probably provide ample water for indoor uses and prevent these adverse effects by prohibiting all outside water uses, including lawn and garden irrigation on a one-time basis to complete the construction. Selection of a wetter than normal year for the construction would mitigate the water supply impact, but might increase the chances that the construction area would be inundated by high flows.

FIGURE 4-1

FLOW DURATION CURVE FOR

EAST & WEST FORKS ASHLAND CREEK
FOR JULY, COMPARED TO CITY WATER DEMANDS



SOURCE: USGS GAGES 14353000 AND 14353500 FOR
WATER YEARS 1926-32 AND 1975-77

The adverse water supply impact would also be partly mitigated by the new (summer 1979) intertie that delivers a supplemental supply to the water treatment plant from Talent Irrigation District facilities. While this water is treated by the city, it is designated for irrigation use only, and may not be available for domestic use. If the city were to develop another alternate water supply in future years, then this impact might be totally eliminated.

Short-term construction impacts, including increased stream flow during reservoir draining, increased traffic on the unpaved road, with dust and motor vehicle exhaust generation, and safety hazard exposure of workers would occur. These impacts are similar to those described for the modification of the water supply intake, except that they would be of longer duration.

- Operational impacts with modified sluiceway outlet

A modified sluiceway outlet would assist in cleaning Reeder Reservoir, particularly following catastrophic sediment inflows. A larger opening, lacking the present taper, and protected by a larger trash rack with remote cleaning capabilities, would allow the city to open the outlet much more easily, facilitating cleaning at the desired times and reducing the risk of a dangerous debris jam in the tapered section. The city would also be able to work at higher flows than is possible at present. (The rate of cleaning is largely limited by manpower and equipment, and greater flows do not necessarily imply faster cleaning.)

- Economic impacts of modifying the water supply intake and modifying the sluiceway outlet

Modification of the water supply intake was estimated to cost from $75,000 to $100,000 by Montgomery Engineers. Modification of the sluiceway outlet, if found feasible, would cost an estimated $100,000, not including the feasibility study, estimated by Jones & Stokes to cost about $15,000. Based on a 1977 population estimated at 14,500, the modifications would have per capita costs as follows, based on 1977 conditions:

Item	Cost	Population	Per Capita Cost
Modify water supply intakes	$100,000	14,500	$ 6.90
Modify sluiceway outlet	$100,000	14,500	$ 6.90
Feasibility study	$ 15,000	14,500	$ 1.03
Total			$14.83

These costs could be recovered through increased charges for water on a one-time basis, or spread out over several years.

- Flow quantity impact due to Reeder Reservoir draining

The draining of Reeder Reservoir, an action embodied in each alternative, increases the quantity of flow in Ashland Creek below the reservoir during the reservoir draining process. The reservoir is usually drawn down over a 4- to 5-week period, and, if full at the start, the stored water will create about a 15 cfs increase in flow if released evenly throughout a 4-week period. Considering a median stream flow of about 10 cfs, the added 15 cfs would bring the total flow to about 25 cfs, as a typical example. Thus, instead of 10 cfs in Ashland Creek, the total flow during reservoir draining might increase to 25 cfs. Natural flow in Ashland Creek can be expected to exceed this flow rate about 20 percent of the time. If natural stream flow into the reservoir were to increase during draining, the rate of draining would be slowed, unless the city increased the discharge rate, which is not normal practice. No adverse impacts of flow increases due to draining are identifiable. The increased flow is likely to increase the downstream movement of the larger stream gravels. In Bear Creek, the effects would be less noticeable.

- Channel aggradation due to eroded materials from Ashland watershed

A substantial volume of sediment is yielded from the Ashland Watershed each year, and an annual average of 18,000 to 24,000 cubic yards is estimated to be likely in the future, subject to wide annual variations in response to normal hydrologic variations. This sediment ranges in composition from fine silts to coarse gravels, with size distributions presently unknown. The fine silts will be carried in suspension downstream into the Rogue River and into the ocean. The larger particles are likely to settle out as the slope of the stream system gradually flattens in a downstream direction. This settling, or sedimentation, will also vary with flow volume, stream velocity and stream geomorphology. It is possible that some or much of this material can settle out along Bear Creek, raising the elevation of the channel bed, and raising the stream surface relative to adjacent ground. If these new sediments become a permanent part of the channel bed and are not eroded out, a situation that can occur through binding by streamside vegetation and reduced flood flows, then aggradation (raising) of the streambed occurs.

It is not presently known whether channel aggradation is occurring along Bear Creek. Following the 1974 flood and reservoir cleaning, significant sediment accumulations were obvious in Bear Creek, and on Ashland Creek above its confluence with Bear Creek. Some of this was mechanically excavated from the creeks and from irrigation canals fed by the creeks, but it is not known if the remainder was eventually flushed through the system or incorporated as part of existing stream gravels. It is believed that most of the fine sediments were flushed through the creek system. The March 1979 testing of stream gravels tends to substantiate this.

However, it is not known if the coarser sediments contributed by Ashland Creek, or other tributaries of Bear Creek in other years, were also washed on through the stream system, or if they have been gradually accumulating.

The volume of sediments supplied by Ashland Creek alone is sufficient to contribute to aggradation. The sudden discharge of sediment in unnatural concentrations relative to stream flow would tend to maximize the opportunity for the material to be bound into the channel by vegetation, particularly if discharged in a year of relatively low stream flow.

Aggradation could also be expected to adversely affect fish habitat by changing the shape of the stream channel, encouraging growth of riparian vegetation, and increasing the percentage of fine sediments to the detriment of salmonid species. These concerns are addressed in Chapter 2, and later in this chapter with the impact discussions on each alternative. If aggradation is occurring, it may be necessary to identify and quantify the sources of sediment as to tributary, and take steps to prevent a significant flood hazard from developing due to a rise in stream elevation relative to surrounding ground.

A reconnaissance study to determine the occurrence and rate of aggradation would be an appropriate study for pursuit through the local 208 program. If it shows positive results, and a continuation of aggradation would appear to create flooding problems, a more in-depth study of the sources of sediment, stream morphology, and possible mitigation measures should be undertaken. Mitigation measures might involve the removal of sediments from Ashland Creek and/or other major sources.

- Siltation of City of Talent municipal water supply intake

The presence of sediments in Bear Creek due to the cleaning of Reeder Reservoir, regardless of cleaning method, is likely to further reduce the usability of the City of Talent's new water treatment plant. Opened in December 1978, the plant takes water from about 10 feet deep in the gravels below Bear Creek, treats it, and pumps it into the City of Talent water supply system. Although the plant has a one million gallon per day design capacity, it has been unable to operate for more than four to six hours at a time without fine sediments from Bear Creek increasingly reducing percolation through the gravels and forcing the plant to shut down for a few hours. Modifications to the intake are underway which, it is hoped, will reduce the effects of fine sediments on the intakes. Increases in the turbidity and sediment loadings from Reeder Reservoir are likely to aggravate this problem, possibly reducing the amount of water available to the City of Talent.

During times of high organic nitrogen levels in Bear Creek during and immediately following reservoir cleaning, the City of Talent may be forced to temporarily discontinue use of the Bear Creek supply to avoid high nitrogen levels in the potable water supply.

- Effects on recreation use and aesthetics

The presence of turbidity, high sediment loads and deposits of bottom sediments will adversely affect recreation use and aesthetics whenever the cleaning or its effects coincide with these uses. While the highest recreational and aesthetic use intensities occur during summer months, some impact occurs whenever cleaning occurs. To the extent that sediments remain in Bear Creek into the summer they may increase turbidities and decrease enjoyment of the stream.

The Bear Creek Greenway, a natural resource, open space and recreational corridor along Bear Creek from Emigrant Reservoir to the Rogue River (also including Ashland Creek downstream from Lithia Park and other tributaries to Bear Creek) is presently being acquired by Jackson County and other agencies. As additional areas become available for public use, this impact of reservoir cleaning on aesthetic and recreational uses will increase.

- Impact on irrigators

The cleaning of Reeder Reservoir can leave sediments in Bear Creek into the irrigation season, adversely affecting irrigators. Regardless of when the reservoir is cleaned, sediments may remain in Bear Creek and be moved slowly as bedload material during the irrigation season (April 15 to October 15). Such bedload material tends to accumulate behind diversion dams, settle out in irrigation canals, and obstruct pump intakes. This sediment must be removed at some cost to the irrigators. However, except for 1974, when cleaning (dredging) occurred between the end of May and early July, the major irrigators on Bear Creek have reported no abnormal sedimentation problems. Thus, while the cleaning of Reeder Reservoir has an impact on irrigators to the extent that sediments remain in Bear Creek into the irrigation season, this is not presently recognized as a serious problem.

Environmental Impacts of Alternative 1 - Spring Draining and Sluicing

In evaluating the environmental impacts of this alternative, it is necessary to rely in part on the city's experience and on observations of stream and water quality conditions following sluicing in prior years. The data available are somewhat limited, but do provide an indication as to the magnitude of some impacts, particularly with regard to water quality and fisheries.

o Practical considerations

A number of factors bear on the timing and duration of spring draining and sluicing. The city must first decide that sufficient sediments have accumulated to warrant cleaning. This decision can be reached by reviewing soundings taken in the lake to measure changes in bottom profile, by visual inspections of the upstream portions of the reservoir at partial drawdown, by inspection of the diversion dams on the East and West Forks of Ashland Creek, or by knowing the general severity of storms in the watershed.

Next the city must decide that there will be adequate spring runoff to refill the reservoir, preventing a water shortage. This is accomplished by monitoring snowpack measurements of the USFS and developing rough estimates of stored water that will later become stream flow.

The timing of the sluicing is also critical. There must not be a hard freeze period during cleaning, or stream flow will decrease to about 2.5 cfs, thus lowering the city's water supply. Further, the exposed silts and muds in the reservoir bottom will freeze and resist sluicing. This constraint generally precludes sluicing prior to February or early March.

Timing is also a factor relative to environmental effects downstream of Reeder Reservoir. The present Water Pollution Control Facilities Permit (DEQ, 1978) restricts discharge to November 15 through March 31 "during periods of high stream flow". The term "high stream flow" is not defined in the permit, and could be interpreted to conflict with the present limited flow range within which sluicing may physically be done.

Once a decision is made to sluice the reservoir, it must first be drained, a process requiring at least 2 to 3 weeks. Higher stream flows can prolong the draining. Historically, the city has usually taken 4 to 5 weeks to complete draining of the reservoir, having selected a target date in advance that allows adequate time to drain and prepare for the cleaning.

The sluicing itself normally requires a period of about 2 to 4 weeks of around-the-clock effort assuming no floods or freezes. The sluicing of about 70,000 cubic yards of sediment in 1976 required 31 consecutive working days. The sluicing involves the use of men and equipment to put moving water in contact with accumulated sediments to wash them through the reservoir and down Ashland Creek into Bear Creek. As the reservoir is drained, the stream flow will cut through the bottom sediments to its original channel, thereby removing some of the sediments. Water is pumped from the stream through hoses and sprayed on the sediments adjacent to the streambed. Limited use of equipment such as small bulldozers may also be made to push sediments into the stream in the reservoir bottom. Heavier equipment is useless unless at least several weeks can be allowed to let the sediments become partly dewatered and more stable.

Debris, including logs, stumps and branches are a part of the material trapped by Reeder Reservoir, and these must by manually removed as they will not pass through the outlet, but instead create a blockage. The amount of such debris varies with the intensity and duration of rainfall in the upstream watershed. When this material is encountered, it is hauled out or dried and burned.

A constant effort is required to keep the sluiceway outlet clear, and a 24-hour/day operation is the most practical way to complete the cleaning. The city will set up portable lighting, hire temporary crews, and maintain an around-the-clock effort to complete the sluicing before interruption by spring runoff, and to enable refilling of the reservoir for water supply carryover for the summer season.

Flow volumes are critical to sluicing. Sufficient stream flow should be present to provide for city water supplies and for sluicing activities. Too much stream flow will exceed the capacity of the dam outlet, forming an increasing pool at the upstream face of the dam, and allowing sediments to settle out prior to passing through the outlet. High flows can also endanger workmen and damage equipment.

The city can regulate flow volumes through Reeder Reservoir to some degree. A 24-inch steel pipeline connects the two diversion dams on the East and West Forks with the 24-inch pipeline that transports water from the dam to the water treatment plant. This pipeline bypasses Reeder Reservoir. It can operate at capacity carrying about 15 cfs, and the surplus flow (above the approximately 5 to 10 cfs needed at the treatment plant to provide the city's water supply) can be released to Ashland Creek at the water treatment plant.

If creek flow volumes are low, the city can reduce its diversions for water supply purposes to about 3 cfs during the day, to optimize sluicing operations. During this cutback the city would rely partly on stored water in system reservoirs to meet water demands. Then at night the city would again divert and treat greater quantities of water to replenish reservoir storage. Sluicing would continue on a 24-hour basis, but with reduced activity at night.

From past experience, the city has determined that a total flow through the reservoir of about 20 cfs is the maximum that can be handled without ponding at the outlet and piling sediment and debris on the screen. The 24-inch pipe bypassing the reservoir can handle an additional 15 cfs.

The minimum desirable flow, per city staff, is about 10 cfs, with 15 cfs being best to work with.

Thus, sluicing is limited to time periods when the total combined flow of the East and West Forks of Ashland Creek is between 13 and 35 cfs, with the optimum flow at about 30 cfs. Table 4-1 illustrates the maximum and minimum conditions for sluicing.

The maximum tolerable flow for sluicing would be considerably increased if the modifications to the sluiceway outlet recommended by Montgomery Engineers (1977) were to be implemented. Enlargement of the outlet to 48-inch diameter from the present 30-inch to 24-inch tapered outlet is suggested. This would allow passage of 80 to 90 cfs through the reservoir without ponding at the outlet. Thus, with the outlet modified, sluicing could be conducted with flows from 13 cfs to about 100 cfs.

This analysis illustrates that, from a practical standpoint, adhering to the DEQ requirement of restricting discharges to Ashland Creek "during periods of high stream flow" may not be possible. Of course, since the city would only drain and sluice in a year with an above-average snowpack, periods of "high stream flow" are likely to occur during snowmelt, although this may be sometime after sluicing. Implementation of this alternative would seem to require modification of the DEQ permit conditions to specify a flow of at least median stream flow volumes (10 cfs), rather than the undefined "high stream flow" term.

Table 4-1

REEDER RESERVOIR SLUICING - WORKABLE STREAM FLOW RANGES

Maximum tolerable flow:	cfs	
E&W Forks Stream Flow	35	
Less 24-inch diversion	-15	5-10 cfs treated for water supply
Flow through reservoir	20	
Flow returned to creek at WTP	5-10	
Flow below WTP in Ashland Creek	25-30	
Minimum working flow:	**cfs**	
E&W Forks Stream Flow	13	
Less 24-inch diversion	-3	all treated for water supply
Flow through reservoir	10	
Flow returned to creek at WTP	0	
Flow below WTP in Ashland Creek	10	

Note: Ignores flows from minor tributaries to reservoir, likely to be of little significance in above flow ranges.

SOURCE: Ed Fallon, Al Alsing, City of Ashland.

o Impact on water quality

Sluicing increases the turbidity, sediment loading and total organic nitrogen levels in Ashland and Bear Creeks, and probably in the Rogue River. The increases exceed levels allowed pursuant to water quality standards both during and for an undetermined period following sluicing. Turbidity and sediment loading increases may last for a month or more, while nitrogen levels tend to return to normal within days of completion of sluicing.

Standards for stream bottom deposits are violated by the sediments, and the adverse effects last until after the sediment has been washed on through the stream system by high flows. This may require from a month or so to more than a year, depending on the quantity of sediment and hydrologic conditions.

Since spring sluicing would involve a continuation of the practices followed in the past by the City of Ashland, the evaluation of its impacts on the water quality of Ashland and Bear Creeks has been largely based on available data on the effects of past sluicing operations on water quality.

Both the RVCOG and the City of Ashland collected water quality data in Ashland and Bear Creeks before, during and after the 1976 sluicing of Reeder Reservoir, which began on February 18 and continued until March 19, 1976. A total of about 70,000 cy of sediment was sluiced from the reservoir during the 31-day period, averaging about 2,000 cy per day (Fallon, pers. comm.). Using USGS flow records for stream flows in the East and West Forks of Ashland Creek, an average stream flow of 13.3 cfs was calculated as entering the reservoir during the sluicing period. Subtracting an average flow of 3.5 cfs (2.25 MGD) which was diverted by the city for water supply during the same period (Fallon, pers. comm.) a net flow of 9.8 cfs is estimated to have passed through the reservoir during the sluicing operation. Freezing conditions in the upper watershed contributed to low flows during this period (Fallon, pers. comm.).

Although a 24-hour-a-day operation was maintained during the 1976 sluicing period, the movement of sediments into the stream channel using bulldozers was limited to the daylight hours, and only sluicing with the pressure hoses and keeping the outlet clear continued during the hours of darkness (Fallon, pers. comm.). For this reason it is estimated that two-thirds of the 2,000 cy of sediment sluiced daily or 1,300 cy was discharged during the 12-hour day shift. With a stream flow of about 10 cfs, the estimated concentration of sediments discharged during the daytime was approximately 85 parts per thousand (ppt), or a dilution of 12:1. Estimated nighttime discharge concentration was approximately 42 ppt, or a dilution of about 24:1. These concentrations result in extremely turbid water.

Of the twelve water quality parameters measured by the RVCOG during its 12-month monitoring program in the Bear Creek Basin, only suspended sediment and organic nitrogen (total Kieldahl nitrogen) levels were significantly affected by the sluicing of Reeder Reservoir (LaRiviere, 1977). Although the concentration of suspended sediments in lower Ashland Creek was only 9.7 mg/l on January 20, on February 24, 6 days after the sluicing operation began, it had increased to 4,658 mg/l or 4.7 ppt at the same location approximately 5 miles below the reservoir (Figure 4-2). The large decrease in suspended sediment concentration which occurred in the first 5 miles of stream below the reservoir (from an estimated 85 ppt to about 4 ppt) indicates that most of the sediment settled out in Ashland Creek, and was transported down the stream and into Bear Creek as bedload material. On March 23, 4 days after the sluicing was completed, suspended sediment levels remained high in lower Ashland Creek, with a value of 2,020 mg/l or 2.02 ppt, and on April 20 still registered 145 mg/l.

As shown in Figure 4-2 suspended sediment levels in Bear Creek below its confluence with Ashland Creek (Stations 1 to 7) were elevated both during the February 23-24 period when sluicing was occurring and the March 22-23 period after sluicing operations had ceased. These levels are high as compared to January 1976 values and as compared to the 1977 values shown in Figure 4-3, covering a similar period when sluicing did not occur. Elevated suspended sediment levels in the middle and lower mainstem of Bear Creek on April 19-20 (a high flow period) indicate that the sediments deposited as bedload in Ashland and Bear Creeks as a result of the sluicing operation may contribute to downstream suspended sediment problems for a considerable period of time after cleaning of the reservoir has occurred.

The following comment on the effects of the 1976 sluicing of Reeder Reservoir on suspended sediment problems in Bear Creek is quoted from LaRiviere, 1977:

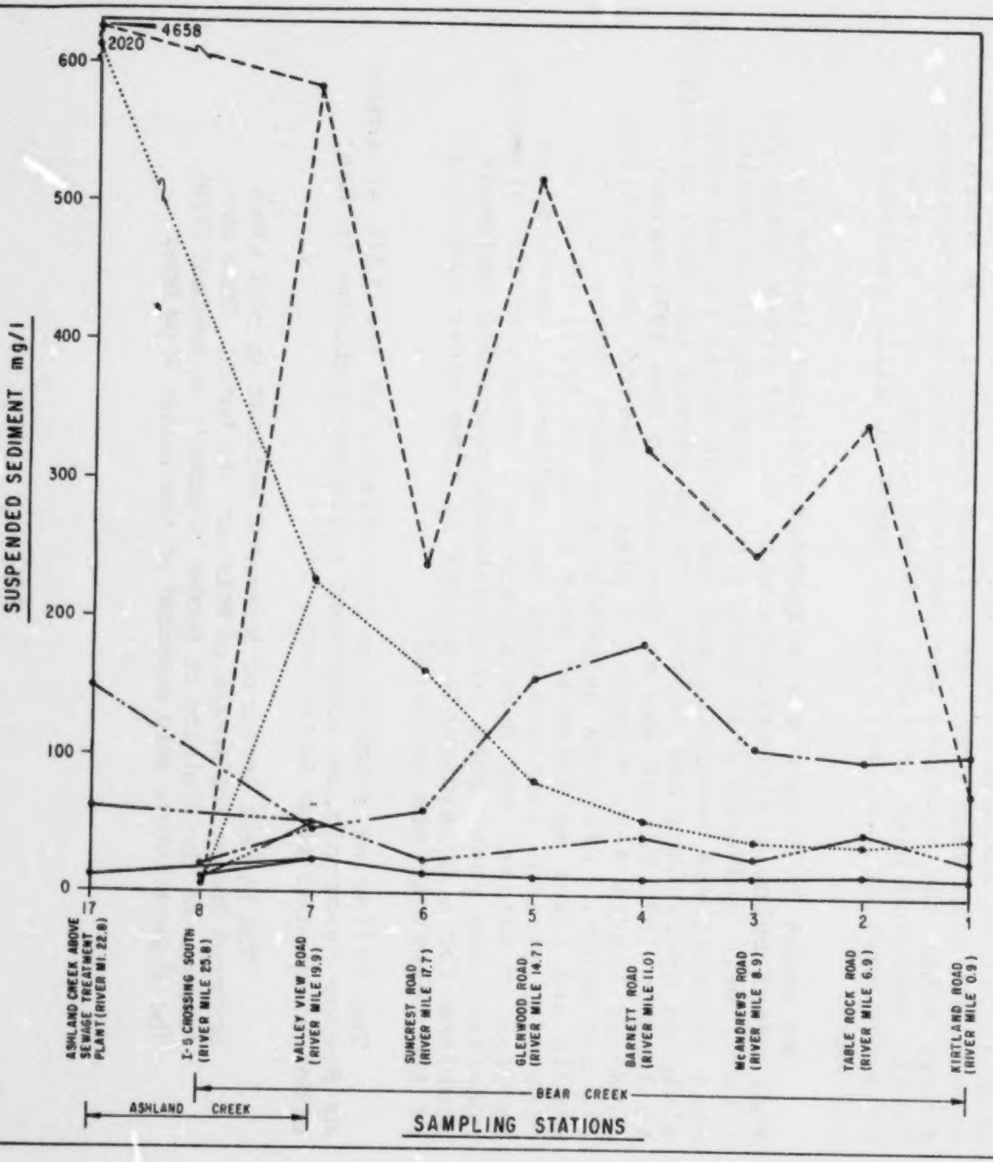
> "The highest levels of suspended sediment in Bear Creek occurred during the months of February and March. This corresponds to the sluicing of Reeder Reservoir on Ashland Creek. The highest levels were measured at the Valley View Road

FIGURE 4-2

CONCENTRATION OF SUSPENDED SEDIMENTS IN

BEAR CREEK BEFORE, DURING & AFTER SLUICING OF REEDER RESERVOIR IN 1976

(BASED ON DATA FROM LaRIVIERE, 1977)



-LEGEND-
- JANUARY 19-20
- FEBRUARY 23-24
- MARCH 22-23
- APRIL 19-20
- MAY 17-18

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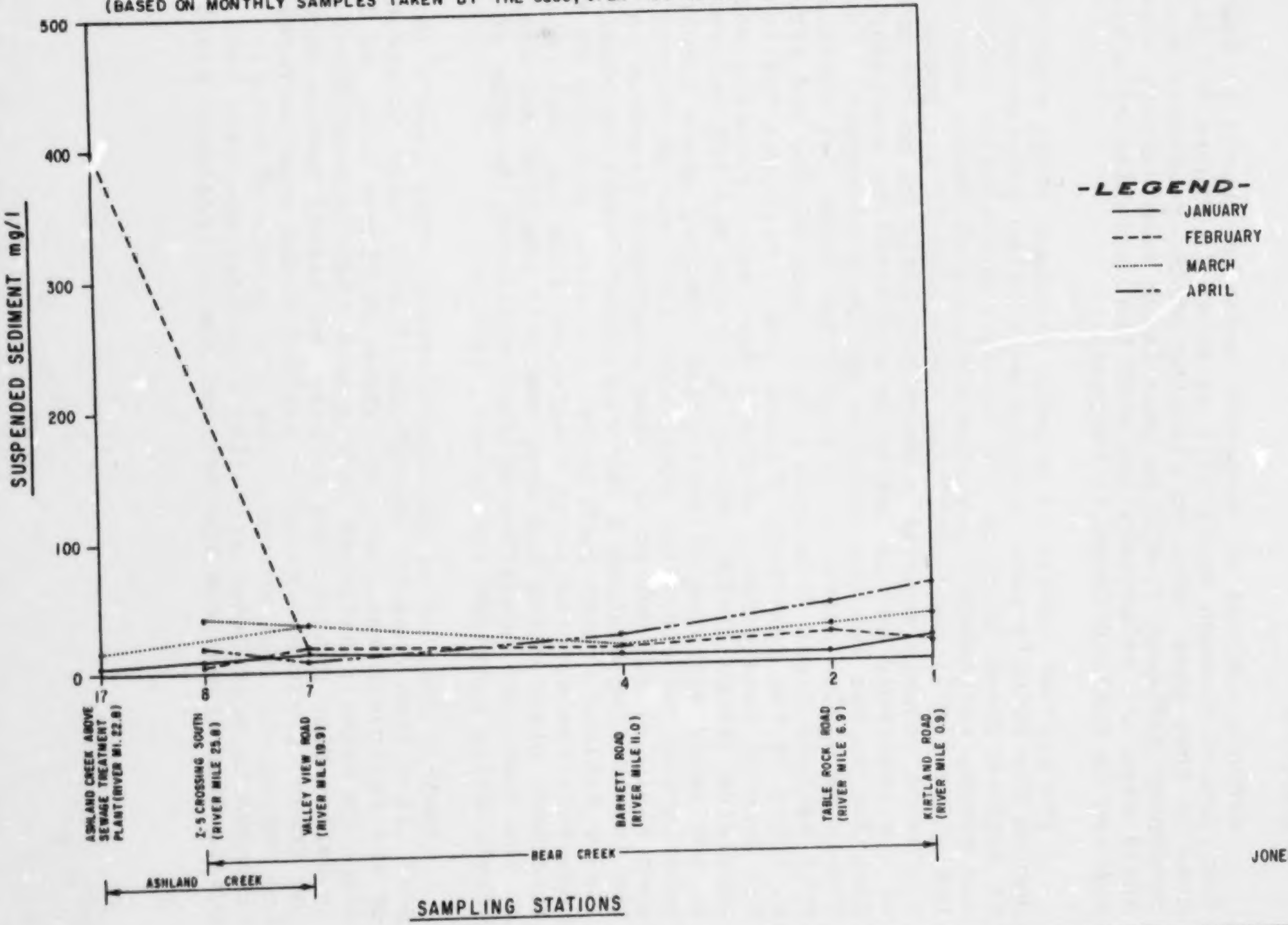
FIGURE 4-3

CONCENTRATION OF SUSPENDED SEDIMENTS IN

BEAR CREEK FROM JANUARY THROUGH APRIL 1977
(BASED ON MONTHLY SAMPLES TAKEN BY THE USGS; OPEN FILE REPORT 78-230, 1978)



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Station [Figure 4-2] and decreased downstream. This is because the majority of the suspended material is granitic particles which settle out of the water column. This granitic material continues to be transported downstream as part of the bedload however, and builds up substantial deposits behind downstream irrigation dams. These deposits are released again at the end of the irrigation season. The actual time of transport through the basin may be several years depending on hydrologic condition."

Monthly samples of suspended sediment levels in Bear Creek for January through April 1977 as shown in Figure 4-3 indicate that in that year, when no cleaning of the reservoir occurred, suspended sediment levels in Bear Creek from January through April were all relatively low with the exception of a high reading in Ashland Creek in February.

The highest levels of organic nitrogen (TKN) reported during the RVCOG's water quality monitoring program were on Ashland Creek (Station 17) during the months of February and March, corresponding to the sluicing of Reeder Reservoir. LaRiviere (1977) concluded that these high levels probably represent organic materials which had built up on the bottom of the reservoir and failed to be converted to inorganic form due to the low temperatures and lack of oxygen. TKN levels were also elevated in Bear Creek below its confluence with Ashland Creek (Stations 1 to 7) both during and after sluicing of the reservoir (Figure 4-4). Although TKN levels had dropped considerably within 3 days after sluicing was completed (March 22-23), March, April and May TKN values in the lower mainstem of Bear Creek remained above January base levels and above the comparable 1977 period (Figure 4-5) when sluicing did not occur. The consistent increase in TKN levels from Station 8 (above Ashland Creek) to Station 7 (below Ashland Creek) both before and after sluicing of the reservoir was attributed to discharges from the Ashland sewage treatment plant which had been recently expanded and was, at the time, not operating at full efficiency because of construction problems (LaRiviere, 1977).

Monthly samples of organic nitrogen (TKN) levels in Bear Creek from January through April 1977, when no cleaning of the reservoir was done, are shown in Figure 4-5. In 1977, although organic nitrogen levels were high in Bear Creek at Valley View Road during January and March, levels above the sewage treatment plant on Ashland Creek were uniformly low during all four months. The high levels of organic nitrogen in Bear Creek at Valley View Road may have been due to discharges from the Ashland sewage treatment plant.

FIGURE 4-4

CONCENTRATION OF TOTAL KIELDAHL NITROGEN IN BEAR CREEK BEFORE, DURING & AFTER SLUICING OF REEDER RESERVOIR IN 1976

(BASED ON DATA FROM LaRIVIERE, 1977)

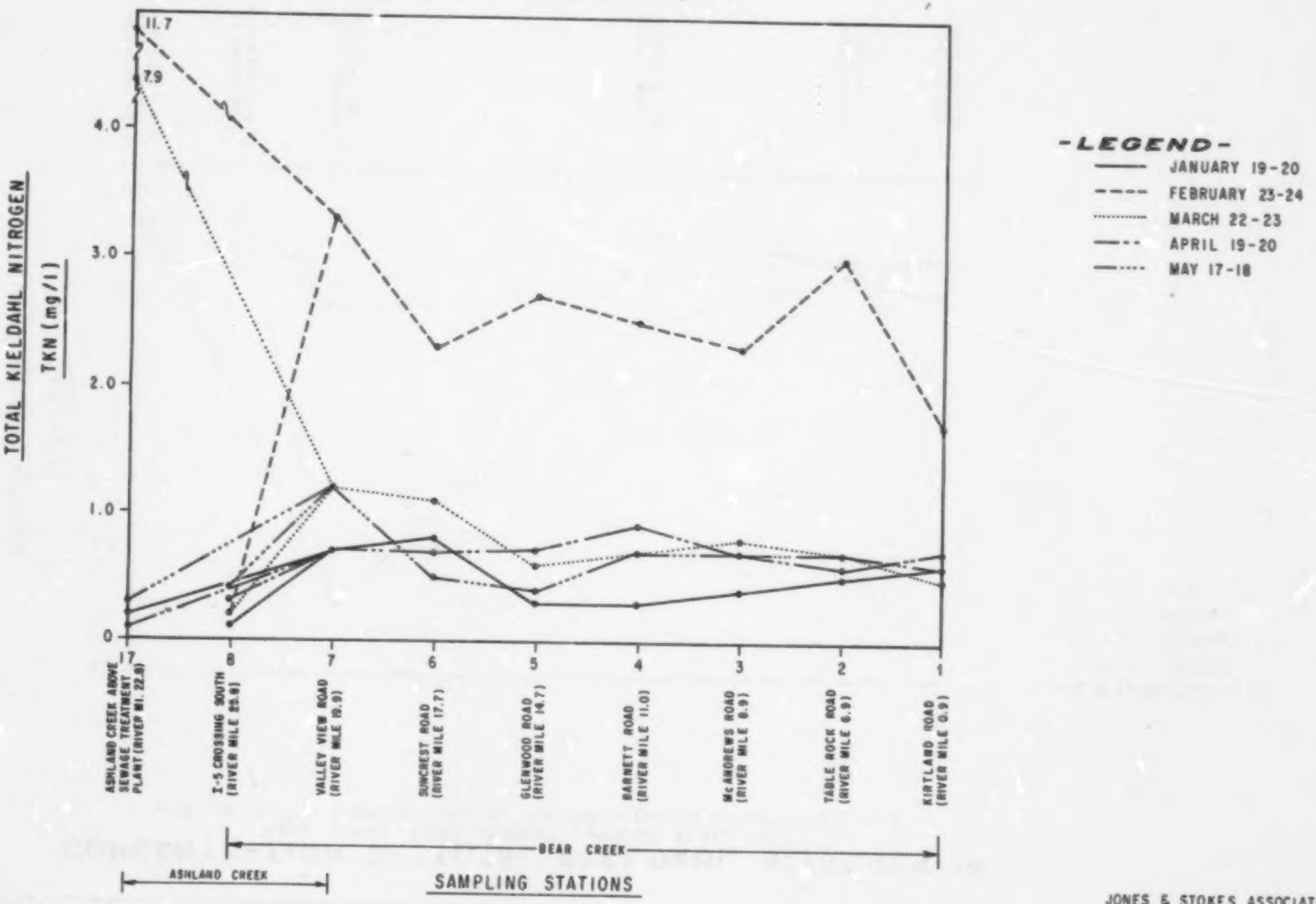

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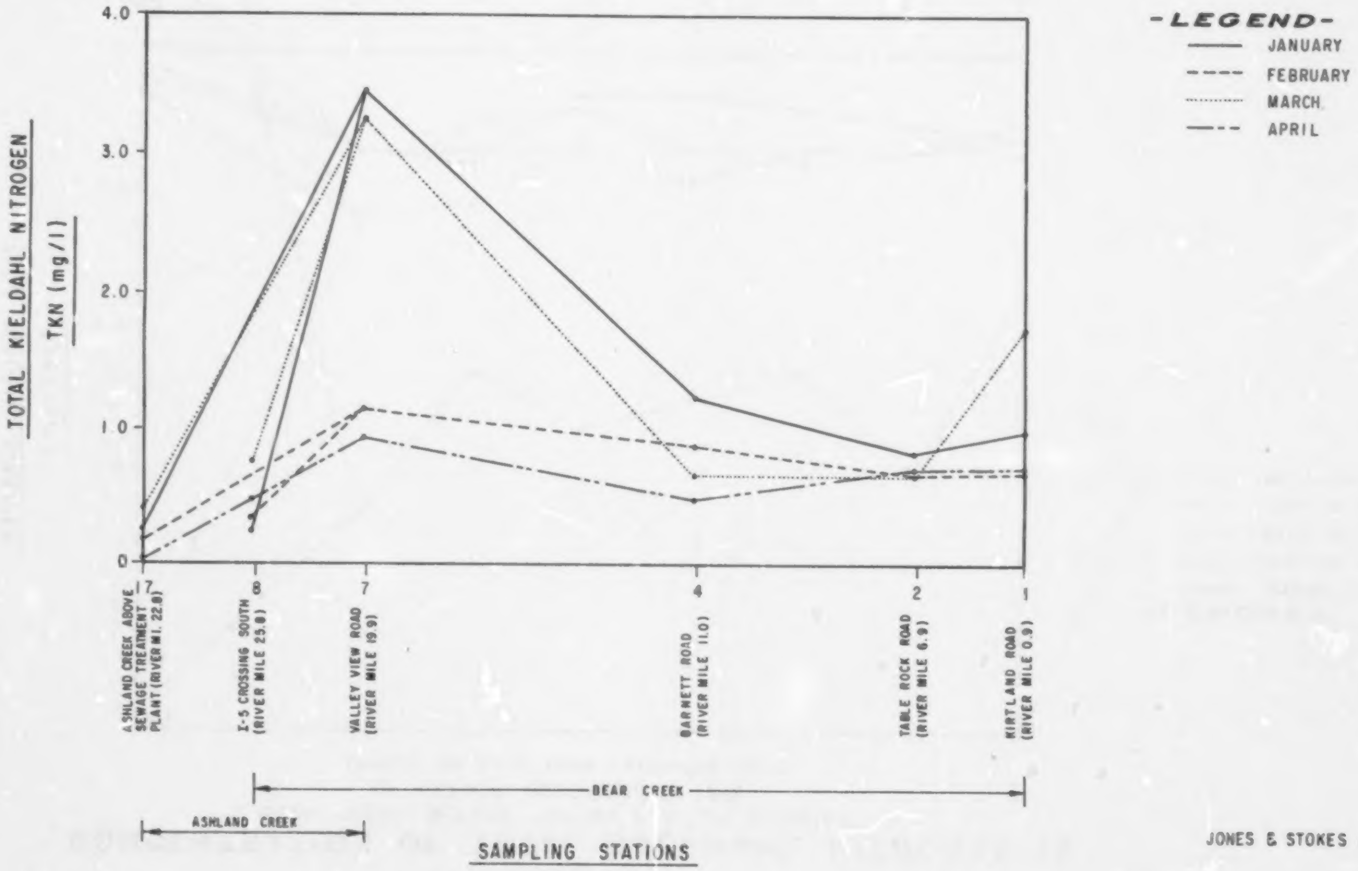
FIGURE 4-5

CONCENTRATION OF TOTAL KIELDAHL NITROGEN IN BEAR CREEK FROM JANUARY THROUGH APRIL 1977

BASED ON MONTHLY SAMPLES TAKEN BY THE USGS; OPEN FILE REPORT 78-230, 1978



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Data collected by the City of Ashland on turbidity levels in Ashland and Bear Creeks before, during and after the 1976 sluicing of Reeder Reservoir show trends similar to those for suspended sediments recorded by the RVCOG sampling program. As is seen in Figure 4-6, turbidity levels in Bear Creek during the sluicing operation (February 18 to March 18) increased by as much as 200 percent just below the confluence with Ashland Creek (Station 2) and remained high throughout the mainstem of Bear Creek, exceeding current DEQ water quality standards restricting turbidity increases to 10 percent above natural background levels. During the last week in March (23-29) turbidity levels had dropped significantly but remained above the presluicing levels (January 9 to February 13) with the exception of Station 4.

In April, which experienced increased stream flows, turbidity levels in Bear Creek were elevated above the January base levels, perhaps due to the large quantities of bedload material remaining in the stream bed after the sluicing of the reservoir was completed. In May and June stream turbidities were again low throughout the mainstem of Bear Creek, similar to the base levels recorded during the pre-sluicing period.

These data indicate that in 1976, the sluicing of Reeder Reservoir created turbidity levels in Bear Creek during the months of February, March and April that were several hundred percent higher than those which existed during the irrigation months of May and June. In 1978, when no cleaning of the reservoir occurred, average monthly turbidity levels in Bear Creek from January through June were all relatively low and no clear differences between the spring and summer months were evident (Figure 4-7).

If future sluicing volumes are similar to those in 1976, an average volume of about 2,000 cubic yards of sediment would be sluiced each day on a 24-hour-a-day schedule, with two-thirds of the cleaning being accomplished during the 12-hour day shift (7 a.m. to 7 p.m.) and the remaining one-third sluiced at night. Assuming a net flow of 10 cfs through Reeder Reservoir into Ashland Creek downstream, the following sediment discharge concentrations would be expected:

Stream Flow	Shift	Discharge Concentration	Dilution
10 cfs	Day	85 ppt	12:1
10 cfs	Night	42 ppt	24:1

FIGURE 4-6

AVERAGE TURBIDITY LEVELS IN
ASHLAND & BEAR CREEK BEFORE, DURING & AFTER SLUICING
OF REEDER RESERVOIR IN 1976
(BASED ON DATA COLLECTED BY THE CITY OF ASHLAND)

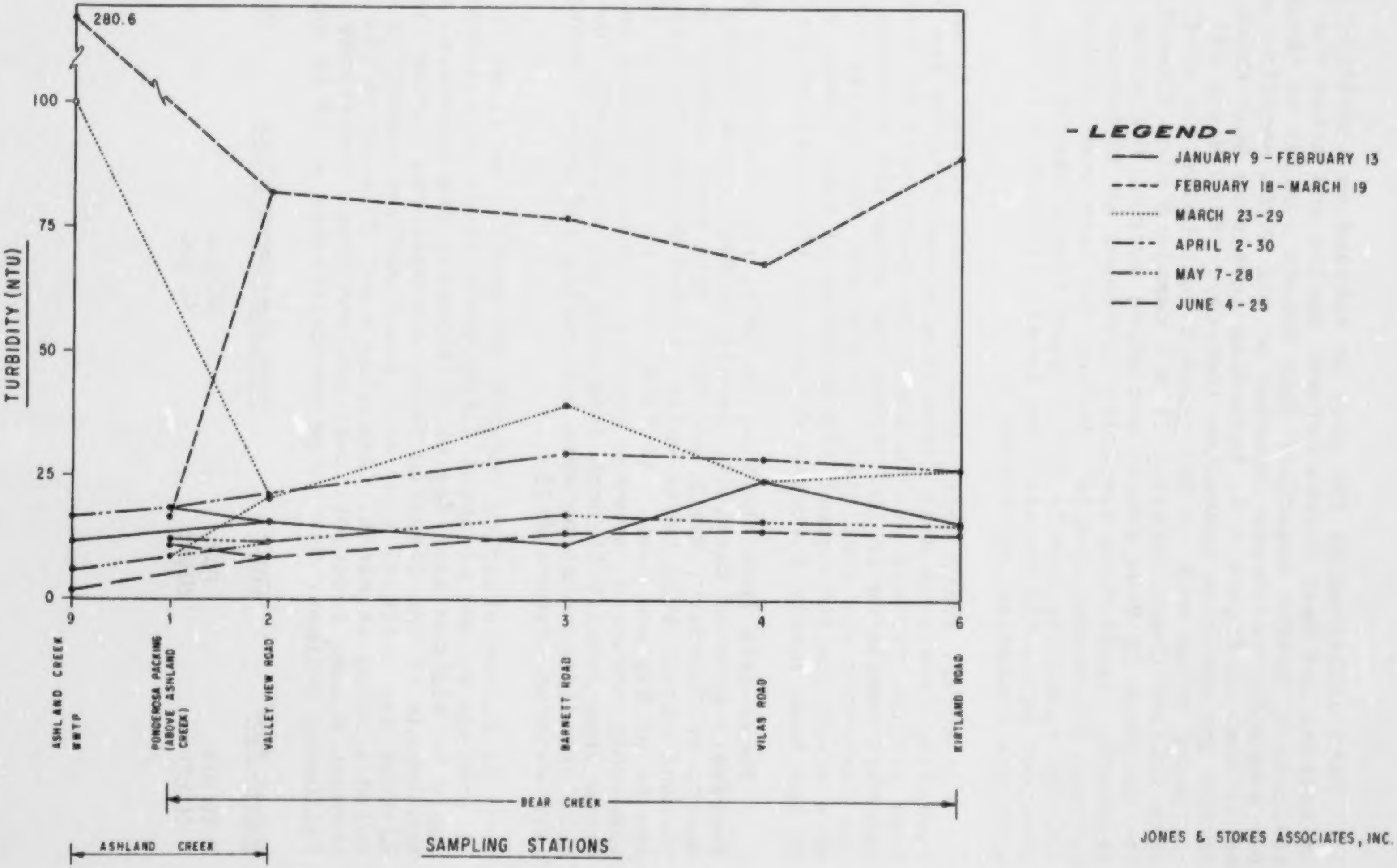

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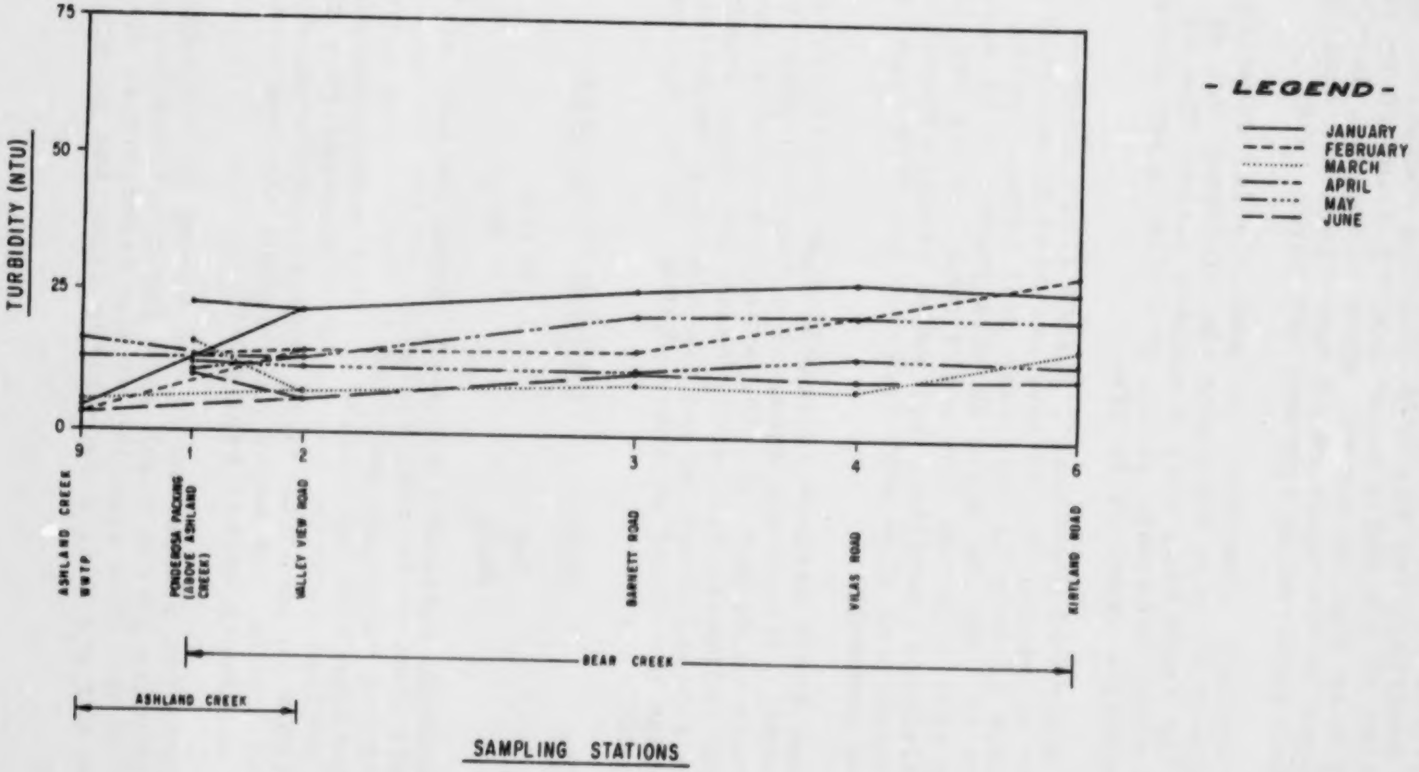
FIGURE 4-7

AVERAGE MONTHLY TURBIDITY LEVELS IN

ASHLAND & BEAR CREEK FROM JANUARY THROUGH JUNE, 1978
(BASED ON DATA COLLECTED BY THE CITY OF ASHLAND)



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Given the above assumptions, draining and sluicing at a minimum stream flow of 10 cfs would produce sediment discharge concentrations and related water quality impacts similar to those described for the 1976 sluicing operation, and result in violation of the DEQ's water quality standard by raising turbidity more than 10 percent above background levels, if stream flows in the mainstem of Bear Creek are similar to those which occurred in February and March 1976.

The maximum tolerable flow possible for cleaning of the reservoir without enlarging the sluiceway outlet is 20 cfs through the reservoir, with a maximum return flow of 10 cfs from the water treatment plant, providing a net downstream flow in Ashland Creek of 30 cfs.

As described previously, stream flows entering Reeder Reserovir exceeding 20 cfs have occurred historically on the average of only 19 days each year between November 15 and March 31. On the basis of this record it is statistically unlikely that a 30 cfs flow would occur during the full duration of the sluicing operation, but would perhaps occur during intermittent peak flow periods resulting from local storm events or snowmelt.

Under these maximum tolerable flow conditions (without outlet modification) and assuming a cleaning capacity of 2,000 cubic yards per day, the average concentrations of suspended sediments discharged below the water treatment plant in Ashland Creek during the sluicing operation is expected to be about one-third of those stated for the minimum 10 cfs flow conditions:

Stream Flow	Shift	Discharge Concentration	Dilution
30 cfs	Day	28 ppt	36:1
30 cfs	Night	14 ppt	72:1

Although suspended sediment concentrations will be less at 30 cfs than at 10 cfs, violation of the DEQ water quality standard for turbidity would still occur. The sediments in suspension will be carried further downstream before settling out as bedload material due to the increased flow rate, and will result in proportionally greater downstream suspended sediment levels, but would help reduce the residence time of the sediments within Bear Creek.

Given the similarity in the trends of suspended sediment and turbidity levels which were indicated before, during and after the 1976 sluicing of the reservoir as shown in Figures 4-2 and 4-6, a two-thirds reduction in suspended sediment concentration should result in a similar reduction in turbidity levels. Background levels may be naturally higher during higher stream flows, and in such cases the violation of the 10 percent turbidity increase standard may not be nearly as great as the several hundred percent increases measured in 1976. As with the suspended sediment load, the related turbidities are expected to persist further downstream before declining under the 30 cfs flow conditions.

If the modifications to the reservoir outlet recommended by Montgomery (1977) were implemented, the maximum tolerable flow for sluicing would be increased to about 80 to 90 cfs through the reservoir, allowing a gross manageable stream flow above the reservoir of approximately 100 cfs. A review of the USGS gauge records for the period from November 15 to March 31, during which reservoir cleaning can occur, indicates that on the average gross stream flows into the reservoir equal or exceed 40 cfs on only 4 days each year and exceed 80 cfs on the average only one day per year. Although high stream flows would not occur often or for long periods, the installation of a larger outlet would allow sluicing operations to continue during peak flow periods.

At a stream flow through the reservoir of 80 cfs and assuming a relatively constant capacity of about 2,000 cy per day, the average concentration of suspended sediments discharged from the reservoir during sluicing operations would be about one-eighth of those discharged at the 10 cfs flow conditions. The resulting suspended sediment and turbidity levels would be lower, although persisting farther downstream. Suspended sediments would be carried further downstream at such high flows before settling out as bedload material, thus decreasing the time of sediment retention and the amount of sediment retained in Bear Creek as a result of the reservoir cleaning operation. Since natural background turbidity levels may be elevated during such peak flow periods, it is not possible to conclusively determine whether violation of turbidity standards would occur due to sluicing of the reservoir, although it appears likely violations would occur.

In addition to suspended sediment and turbidity, accumulations of sediments in the channel of Bear Creek are a problem resulting from sluicing, and violate DEQ standards prohibiting the formation of bottom deposits deleterious to fish or other aquatic life. Sediment accumulations in Bear Creek depend on the amount and timing of the spring sluicing, and the ability of Bear Creek flows to flush sediment on through into the Rogue River. No studies of sediment movement in Bear Creek have been conducted, and it is not known how long it would take at various flow rates to flush sediments out into the

Rogue River, and hence to the ocean. However, reports by irrigation operators indicate that it takes at least some months for sediment to move on through Bear Creek, based on their observations after the 1974 dredging of Reeder Reservoir. LaRiviere (1977) indicates it may take from several months to several years depending on hydrologic conditions.

An arbitrary flow value of 500 cfs was selected for purposes of evaluating the probability of "high" flow on a month-to-month basis during the winter season. While 500 cfs may or may not be high enough to effectively move most bedload material, the use of an arbitrary value does permit evaluation of the relative likelihood of high flows at various times of the year. Flows of over 500 cfs occur on Bear Creek in most years, but the chance that this flow will occur between March 15 and April 15 (start of the irrigation season) is only about one in seven. The probability that sediment could be moved through Bear Creek following spring draining and sluicing appears low in most years.

Thus, violations of the bottom deposit standards are likely to occur following the initiation of sluicing, and to persist from a month or so to a year or more. These duration times are speculative, since no long-term monitoring of bottom sediments has been conducted. Sampling in March 1979 indicated no detectable residual violations resulting from the February-March sluicing in 1976, illustrating that Bear Creek was essentially cleansed of the sediments after three years.

It might be possible to mitigate water quality impacts by artificially augmenting stream flow during or following sluicing. Such augmentation could be achieved by releases down Bear Creek from Emigrant Reservoir. However, at present the reservoir does not have water available for such purposes, the magnitude and duration of mitigating releases that would be needed is unknown, and their relative effectiveness is not known. If more were known about sediment movement in Bear Creek in response to flow, then investigation of such a mitigation measure might be justified.

By only sluicing during relatively wet years, the city helps mitigate the water quality and sediment accumulations to a degree, since in years with a substantial snowpack the runoff later in the spring is likely to be above average. This helps to move the sediments on through the stream system more rapidly. However, it does so at a time that is undesirable from a fisheries standpoint.

o Impact on anadromous fisheries

High turbidities from sluicing Reeder Reservoir may result in increased mortality in summer and winter steelhead trout, coho salmon, and chinook salmon by suffocation and abrasion, may inhibit migration of fish, and make stream gravels unsuitable for spawning. Abrasion and covering of stream organisms eliminates sources of food for adults and fry, further increasing mortality. The adverse conditions persist until sufficient stream flows flush sediments through the Bear Creek and the aquatic habitat can recover.

The impacts of the proposed draining and sluicing operation on the anadromous fisheries resources of the Bear Creek system are evaluated using information available on the effects of past reservoir cleaning operations on the biota of Bear Creek, and information from the literature on the effects of stream sediments on salmonid fisheries.

In March 1973, due to its prime concern that the sluicing of Reeder Reservoir was occurring during the peak season (February to March) for annual adult steelhead trout inmigration and spawning in the Bear Creek system, the Oregon State Game Commission (OSGC) requested that the DEQ investigate the severe turbidity and sedimentation conditions which were being caused by the reservoir cleaning operation. During the 1973 sluicing of the reservoir turbidity levels in Ashland Creek reached 1,500 JTUs and suspended sediments were carried out into Bear Creek and the Rogue River, with turbidity in Bear Creek at Medford measuring 50 JTUs. Associated with this was a bedload of sediment from the reservoir which was carried, in diminishing proportions, down Ashland Creek and into Bear Creek (DEQ, 1973). As a result of its investigation DEQ concluded that "water quality and other aquatic habitat were broadly impaired" due to the sluicing of the reservoir, and that the operation posed "a hazard to fishery production."

As indicated above and by analyses of the ODFW described in the last section of this chapter regarding cleaning following sediment inflow, the discharge of sediments into Ashland and Bear Creek may have a major adverse impact on the salmonid fishery of the Bear Creek system. Reviews of the literature on the specific effects of stream sediments on salmonid fisheries indicate that all life history stages of salmonids while in freshwater may be adversely affected by either suspended sediment or bottom sediments (Cordone and Kelley, 1961; Phillips, 1971; Iwamoto, et al., 1978; OSGC, 1970). Turbidity and suspended sediment levels from 200 to 300 mg/l may cause increased mortalities among both adult and juvenile salmonids due to clogging of the gills with fine sediments and subsequent suffocation, as well as abrasion of the gills and body surface from suspended sediments, causing increased stress and exposure to disease (Phillips, 1971). Similar turbidity and suspended sediment levels may also inhibit spawning in streams that are otherwise suitable as spawning habitat. Adult salmonids may avoid turbid water streams and select other streams for spawning, or may pass through turbid areas and spawn in clear side tributaries if access is available (Cordone and Kelley, 1961).

In a review of the literature on the effects of sediments on the gravel environment and fish production, Phillips (1971) found that sediments less than 4 mm in diameter which settle on the gravel substrate are harmful to salmonids in a number of ways. These sediments fill the intergravel spaces and reduce the flow of water within the gravel bed. This inhibits the development of the eggs due to the lack of an adequate oxygen supply and a reduction in the removal of metabolites such as carbon dioxide and ammonia. Sediments which fill the intergravel spaces also form a barrier to the emergence of young fry after hatching. Both reduced oxygen levels and the physical barrier effect of sediments appear to be additive in reducing the spawning success of salmonids. Stream sediments as large as 8 mm also adversely affect the survival of salmonid fry after emergence by filling in the gravel spaces which the fish use as escape cover and also provide habitat for aquatic insects that serve as the main food source for young salmonids. Accumulation of sediments within or on top of loose stream gravels also compacts or cements them, making the area unsuitable as spawning substrate for inmigrating adult salmonids.

On the basis of the information provided in the literature and the reports of the effects of the 1973 and 1974 cleaning of Reeder Reservoir on the stream biota, it may be concluded that the discharge of sediment into Ashland and Bear Creeks has both immediate and residual adverse impacts on the salmonid fishery of the Bear Creek system. A review of the timing of the life history stages and the environmental needs of the four anadromous salmonids found in the Bear Creek system, as presented in the Environmental Criteria Guidelines (see Appendix D), indicates that the discharge of granitic sediments from Reeder Reservoir into Ashland and Bear Creeks during February and March may have the following adverse impacts on the salmonid fishery: 1) high turbidity and suspended sediment levels in Bear and Ashland Creeks during February and March may result in increased mortalities due to suffocation and abrasion among inmigrating and outmigrating adult summer and winter steelhead trout, outmigrating steelhead and coho salmon smolts, and newly emerged fry of coho and chinook salmon and winter steelhead which were spawned in the mainstem of Bear Creek, as well as summer steelhead fry spawned in Ashland Creek below Reeder Reservoir; 2) these same conditions may also inhibit the movement of adult summer and winter steelhead trout into the Bear Creek system, as well as inhibit the spawning of those steelhead which do move up into Bear Creek; 3) the silting of the streambed in Ashland and Bear Creeks with granitic sediments during February and March may make the gravels unsuitable as spawning substrate for summer and winter steelhead; smother any eggs already spawned by steelhead, coho salmon and chinook salmon; inhibit or prevent the emergence of any fry which do hatch, and eliminate the intergravel spaces used as cover by young salmonid fry and the aquatic insects on which they feed. The elimination of cover and food organisms in the mainstem of Bear Creek adversely affects not only the salmonid fry which emerge there but also summer steelhead fry which migrate out of the tributary streams and down through Bear Creek during the spring months. Unless sufficient peak flows in Ashland and Bear Creeks occur during the following spring months to scour the stream gravels and remove the fine sediments, the adverse conditions caused by the silting of the streambed may persist, until sufficient stream flow does occur.

- Water supply impacts

The City of Ashland has reportedly never experienced any adverse water supply impacts following spring draining and sluicing. Adequate runoff has refilled the reservoir to sufficient levels to provide carryover throughout the summer and fall. Continuing stream flow plus the storage provide for the city's entire domestic supply. The practice of monitoring the snowpack in the watershed and only draining and sluicing during wet years helps ensure that the city will not fail to refill the reservoir from snowmelt.

Montgomery (1977) concluded that the city could no longer expect to drain the reservoir for cleaning, since water demands are projected to increase, and the storage of Reeder Reservoir will be of ever increasing importance to meeting summer and fall demands. Their analysis indicates that by the year 1984 water demands will have grown such that a dry cycle of two years could result in the city running out of water, even if the city develops its rights to 800 acre-feet of TID water.

They state that "the disadvantage of this method (draining and sluicing) is that the reservoir must be emptied in order to accomplish the sluicing operation and the City of Ashland cannot afford to deplete its water supply in this manner, on the chance that the runoff will not be sufficient to refill the reservoir for summer storage." (Montgomery, 1977).

Montgomery (1977) projects total water use of 7,040 acre-feet per year by the year 2000, the use of which would presumably be distributed through the year in the same proportion as now occurs. Thus if the reservoir were drained and sluiced, and refilling began on April 1, 1,940 acre-feet would be needed to meet April, May and June demands, about 360 acre-feet would be needed to maintain a 2 cfs flow in Ashland Creek for downstream water rights, and 860 acre-feet would be needed to refill the reservoir to the top of the spillway gates, for a total of about 5,100 acre-feet between April 1 and July 1.

Review of USGS gauge records of inflow from the East and West Forks of Ashland Creek reveals that of 10 years of available record (water years 1926-1932 and 1975-1977) that 5 years would have produced sufficient runoff and 5 would not. Two of the years provided more than twice the required runoff, while 3 years provided less than half of the required amount.

The Montgomery concern about lack of sufficient runoff is well founded. However, if the city continues its practice of monitoring the snowpack and decides in early February that there are above-average amounts of moisture stored in the watershed that will later refill the reservoir, they should be able to implement this alternative until at least the year 2000 without threat to the water supply. Draining could not be attempted during average or dry years, but sediment inflows are likely to be small then in any event. With proper precautions, no adverse water supply impacts are envisioned with this alternative.

o Economic impacts

The economic effects of continued spring draining and sluicing are primarily fishery losses and the costs of labor and equipment rental. In 1976, the city sluiced about 70,000 cubic yards at a total cost of about $25,600, or $0.37 per cubic yard (1976 dollars). During the time that the reservoir is drained, the city may also incur greater water treatment costs for chemicals and filter cleaning if there are turbid flows in the East and West Forks of Ashland Creek. However, the timing and duration of such events vary with hydrologic conditions and these costs are probably minor. Since the city will be able to meet water demands during spring sluicing, no water revenues would be lost. Thus the annual costs (1977 dollars) for sluicing can be estimated at $0.39 per cubic yard times the 18,000 to 24,000 cubic yards, or an average annual cost of $7,000 to $9,400. To this must be added those losses to the fisheries of Bear Creek that would occur in those years when sluicing was accomplished. Those costs would be $67,500 (1977 dollars), assuming total loss of one year's spawn. Also, if residual sediments affected the following year's spawn, then additional losses would result.

Estimation of annual fishery losses due to this alternative is somewhat speculative. Hydrologic records indicate that Reeder Reservoir could only be drained for cleaning in about one-half of the years without jeopardizing summer water supplies. Thus, at most, total fishery losses could only occur in one-half of the years. Further, the volume of accumulated sediments would vary unpredictably from year to year. Infrequent major floods would contribute most sediments, and intervening years might see little sediment entering Reeder Reservoir. The sluicing of relatively small sediment volumes would most likely not cause total losses to the year's spawn, although insufficient data exist to define any quantitative relationships between sediment quantity and fishery losses.

For costing purposes, it is arbitrarily assumed that sluicing would occur in one-half of the years, fishery losses would be one-half of total value, and there would be no allowance for residual damage for the year following sluicing. Based on these assumptions fishery costs would equal about $16,900 per year.

Thus, the total annual cost of this alternative would be about $23,900 to $26,300 per year (1977 dollars).

o Other impacts

Workers conducting the sluicing operation face some safety hazards. The sediments can behave like quicksand, and liquefy under loading or equipment vibration. This can result in injury, or in equipment loss or damage. Vertical walls of sediment can also suddenly cave, threatening men and equipment.

The task of keeping the outlet screen free of debris is an equally dangerous task, risking falls, entrapment in debris, and serious injury or drowning. This could be mitigated by an enlarged outlet and by screens that can be cleaned by hydraulic or mechanical means from a distance. The nighttime operations are also somewhat dangerous. Adequate lighting can reduce these hazards.

Environmental Impacts of Alternative 2 - Dredging During High Stream Flow

The timing of many of the impacts of dredging is as uncertain as the weather. The timing of periods of "high streamflow" is not predictable, and whether this alternative would be operated in any given year is not known. In addition to the impacts described in this section, the city indicates that occasional draining and sluicing will be necessary to remove material missed by dredging, thereby implying that the impacts of Alternatives 1 or 3 would occasionally occur (every 3 to 4 years).

The evaluation of the dredging alternative is based in part on the observations made in 1974 and 1976 following cleaning of Reeder Reservoir. It is important to note that dredging would release sediments to Ashland Creek below the dam at about the same rate as sluicing. Thus, many of the impacts are similar, with the exception of those that change with the timing.

o Practical considerations

The factors bearing upon the timing and duration of dredging are fewer than for draining and sluicing. Once the dredge has been purchased and is in place in Reeder Reservoir, a decision to dredge could be made and implemented within the 16-hour notice required by DEQ. Dredging can be conducted as long as flows in the East and West Forks are adequate to provide the city's water supply. (Since dredging greatly increases reservoir turbidity and turbid water is more costly to treat, dredging should be avoided during periods when the reservoir water must be used for water supply. This occurs when combined flows of the East and West Forks drop below 5 or 6 cfs.)

Freezes, heavy snow, rain and high wind could prevent use of the dredge. A crust of ice on the reservoir could damage the floating dredge, and would prevent its use. It might be necessary to remove the dredge from the reservoir to a dry dock during the initial stages of any ice formation as a precautionary measure. Such a dry dock facility would probably need to be usable from a wide range of reservoir levels.

Montgomery (1977) estimates that, on a 16-hour, two-shift basis that about 1,000 cubic yards per day could be removed with a 12-inch hydraulic dredge. This rate is similar to the 2,000 cubic yards per 24 hours that would be discharged by sluicing. The Montgomery time estimate includes allowance for about 25 percent downtime for repairing the dredge, removing debris clogging the intake, and other typical operational problems.

The ability of the city to locate and successfully employ qualified operators for either a single or double shift deep-water dredging operation is not known. Since operation in up to 100 feet of water requires specialized equipment and skilled operation, experienced personnel are essential. Full-time staff with split responsibilities, or contract labor during the rainy season, would be the main options open to Ashland.

The DEQ permit requires that discharge of sediments from Reeder Reservoir be accomplished only between November 15 and March 31, and only "during periods of high stream flow". The term "high stream flow" is undefined in the permit, although it might be assumed to be any flow higher than the median which is 10 cfs for the combined flows of the East and West Forks of Ashland Creek. Such an assumption allows evaluation of the practicality of meeting such flows.

Periods with flows above 10 cfs are not predictable, but they do occur in a sufficient number of days each year to allow an ample number of dredging days between November 15 and March 31 of most years to remove more than the estimated average annual volume of sediments. Such flow periods are more likely to occur in the later portions of the November 15 to March 31 permitted discharge period than toward the beginning.

Another interpretation of the "high stream flow" term in the DEQ permit might be a value of twice the median stream flow value, or about 20 cfs. From a review of USGS gauge records for period of "freshets", it appears that, on the average, flows into Reeder Reservoir exceed 20 cfs about 70 days per year, but most of those days occur after the start of the irrigation season on April 15. If no dredge discharge could occur after March 31, the DEQ permit date, then only on an average number of 19 days per year during this period would flows into Reeder Reservoir exceed 20 cfs. (In prior years, this has varied from zero days to 59 days.) If 20 cfs or more were to be the definition of "high stream flow", an average maximum of about 20,000 cubic yards of sediment could be discharged each year by dredging. If sediment inflows average more than this, the city could not keep up with the inflows.

In any event, periods of "high stream flow" are not predictable during the November 15 through March 31 period (or at any other time) and suitable dredging times may or may not occur, depending on definitions and meteorological events. Storms and high winds could also coincide with times of high stream flow, preventing dredging during some of the already limited opportunities. This further indicates that the city may have a difficult time accomplishing dredging to keep up with sediment inflows if a 20 cfs criterion were applied.

Regardless of how the term "high stream flow" is interpreted, there must be an adequate flow in Ashland Creek below the dam to wash the sediments downstream into Bear Creek. It is estimated that a flow of about 10 cfs, similar to the minimum flow needed for sluicing, would be required. If Reeder Reservoir is full when the high stream flow occurs, the difference between inflow and the city's water use will flow over the spillway and provide the water necessary to wash the sediments downstream. But if the reservoir is not full when dredging is conducted in accordance with the DEQ permit, stored water must be released from the reservoir to make up at least a 10 cfs stream flow.

The fact that reservoir releases might be necessary to dredge sediments even during high stream flow periods raises the question of whether dredging could be implemented pursuant to the DEQ permit by merely releasing a "high stream flow" from the reservoir into Ashland Creek. This could be done whenever sufficient storage was available in Reeder Reservoir, without regard to inflow or the flow volume of any other streams in the basin. Such an approach would allow the city to select any time period or periods desired between November 15 and March 31 for dredging. The timing would be selected to help overcome some of the disadvantages of dredging, such as interference from hazardous weather coincident with high stream flow periods or freezing of the reservoir surface.

- Water quality impacts

Dredging would cause the same water quality problems as sluicing, namely high turbidity and sediment loading, high total organic nitrogen, and creation of stream bottom deposits. These violations would occur in Ashland Creek and Bear Creek, and effects would continue downstream into the Rogue River, following each dredge discharge period. Turbidity and sediment load increases may last for a month or more, while nitrogen increases will return to normal within a few days of discharge cessation. Bottom deposit violations may last for months or longer until flush-out by high stream flow.

Since "high flow" periods are undefined, and in any event are unpredictable, the time or times of dredge discharges are not predictable. Dredging may occur early, late, or sporadically, depending on climatic conditions.

Using Montgomery's (1977) suggested dredging rate of 1,000 cubic yards per 16-hour work day, and assuming stream flows of from 10 to 20 cfs in Ashland Creek below the dam, the estimated concentration of sediments discharged by the proposed dredging operation would range from 47 ppt to 23 ppt, or a dilution of from 22:1 to 43:1.

However, as the volume of flow in Ashland and Bear Creeks increases, the sediment will be increasingly diluted. Further, high natural flows will be more turbid than low flows. Thus dredged materials released during higher flows will cause proportionately lower percentage increases in turbidity levels and sediment loading. The sediments are also likely to be carried through the Bear Creek stream system sooner during higher flows, decreasing the time that bottom sediments adversely affect spawning gravels.

Given the above estimates and assuming that the majority of dredging would occur at flows from 10 to 20 cfs, the average sediment discharge concentration and associated turbidity levels would be slightly less than those experienced during the 1976 sluicing of Reeder Reservoir (though they could still show a several hundred percent increase in turbidity levels in Bear Creek, causing violations of the DEQ water quality standard for turbidity. However, due to the fact that the occurrence, magnitude and duration of "high stream flow" periods during the winter months is unpredictable, it is impossible to assess the magnitude and duration of the impacts which the dredging operation would have on water quality in Ashland and Bear Creeks. During years when flows fluctuate around the median of 10 cfs for both forks of Ashland Creek, dredging activity may be sporadic, producing high sediment discharge concentrations and associated turbidity increases, with large percentage violations of the DEQ turbidity standards. During wet years, however, the majority of the dredging activity may occur during continuous periods of flow above 20 cfs. This would produce somewhat lower suspended sediment discharge concentrations and associated turbidities, and reduce the amount of time it takes to move the deposited bedload material through Bear Creek and into the Rogue River, although violation of DEQ turbidity standards may still occur.

o Anadromous fisheries

Since the proposed dredging of Reeder Reservoir may occur as one continuous operation during a high flow period (such as occurred in 1974 with a stream flow estimated at about 50 cfs), or sporadically throughout the winter, depending on climatic conditions, its immediate impact on the salmonid fisheries of the Bear Creek system may vary from year to year. As is indicated in the Environmental Criteria Guidelines for salmonids presented in Appendix D, the discharge of sediments during November and December would have an immediate adverse impact on the inmigration and spawning of adult chinook and coho salmon. High turbidity and suspended sediment levels may result in increased mortalities due to suffocation and abrasion, inhibit the movement of adult salmon into Bear Creek, and inhibit the spawning of those salmon which do enter Bear Creek. Silting of the streambed may also degrade the quality of the spawning gravels and smother the eggs already spawned by chinook and coho salmon.

If dredging activities occurred during the period from January through March, the immediate impacts would be more extensive, as described for the February to March sluicing of the reservoir in a prior section. During this period high suspended sediment and turbidity levels would adversely affect inmigrating and outmigrating adult summer and winter steelhead trout, outmigrating steelhead and coho salmon smolts and newly emerged fry of coho and chinook salmon and summer and winter steelhead. Silting of the gravels with granitic sediments during this period would also degrade the quality of the spawning gravels, smother eggs already spawned and eliminate rearing habitat for salmon and steelhead fry. If peak scouring flows do not occur during the winter and spring months to remove the accumulated sediments from the stream gravels, salmonid habitat in Ashland and Bear Creeks will remain degraded until sufficient peak scouring flows do occur to clean the stream gravels.

- Water supply

Dredging Reeder Reservoir does not require draining and therefore largely foregoes the risk of losing storage needed for water supplies. However, the occasional draining, necessary to remove sediments not amenable to dredging and to inspect the reservoir, would have the same impacts as Alternatives 1 or 3, depending on when the cleaning was to take place. Dredging itself requires the flow to operate the dredge, and a flow in Ashland Creek (or reservoir release to provide this flow) to carry the sediments downstream.

If dredging is implemented with a partially full reservoir, the release of 10 cfs to carry dredged sediments downstream requires about 14 acre-feet per 1,000 cubic yards of sediment.

Given a reservoir capacity of 860 acre-feet to the top of the spillway gates (Montgomery, 1977), one day of dredging costs 1.6 percent of reservoir storage. Dredging 18,000 to 24,000 cubic yards over 18 to 24 days would require about 30 to 40 percent of Reeder Reservoir volume. This may constitute a risk to the city's water supply in the following summer if sufficient spring runoff does not refill the reservoir. It seems likely that dredging would be deferred by the city until a sufficient snowpack was present or until the reservoir is full. This procedure would preclude any adverse water supply effects, but might limit the flexibility of dredging somewhat.

The dredging will cause turbidity in the reservoir at the water supply intake, which would make treatment for domestic use more costly. This can be mitigated by taking water at the upstream diversion dams, or by taking water from a different level of the reservoir, if the recommended modifications to the water intake are made.

- Safety

Operation of a dredge on Reeder Reservoir poses some safety hazards to workers. The constraints of the DEQ permit, namely restricting dredging to the periods from November 15 to March 31, and only during periods of "high stream flow", would seem to increase the workers' exposure to storm conditions, including snow, rain and wind. Operating major mechanical equipment in deep water under such conditions may pose some threats of serious injury or even death unless extreme caution is exercised.

- Economic impacts

The economic effects of dredging are primarily those of amortizing dredge costs, periodic operating costs, and fishery losses. Montgomery (1977) estimates the dredge to cost $300,000 to $350,000 complete, and annual operation to be $6,000, assuming operation by city employees. They further indicate annual costs amortized over 20 years of $31,000 for sediment removal (1977 dollars). Assuming dredging is 75 percent efficient, 25 percent of the sediment would be sluiced, at an average annual cost of about $2,300.

To this must be added the fishery losses, which could be equal to or less than those for sluicing, depending on the timing of dredging. If the same losses as for sluicing are assumed, an annual cost of $16,900 for fishery losses can be assigned to the dredging alternative.

Thus, the total annual cost of this alternative would be about $50,200 (1977 dollars).

Environmental Impacts of Alternative 3 - Fall Draining and Sluicing

An identified purpose of the cleaning of Reeder Reservoir in the fall rather than in the spring is to allow the high winter and spring flows to flush the sediments on through the stream system, minimizing conflicts with the fisheries and irrigators. This would theoretically lessen the potential for siltation in diversion dams on Bear Creek, reduce irrigation canal maintenance, and reduce fisheries conflicts.

- Practical considerations

The timing of fall draining and sluicing would probably be scheduled to follow the end of the irrigation season, so that sluicing could begin as early as possible. Flows in the two forks of Ashland Creek are likely to be at or less than median flows, meaning that sluicing cannot be effectively carried out until flows reach at least 10 cfs. Thus it is possible that the reservoir could sit empty for weeks or months prior to sluicing, or that the city would have to use fewer hoses and less equipment, working more slowly. For evaluation purposes it is assumed that the latter course of action could be implemented, and that sluicing would be complete by the end of the calendar year.

- Impacts on water quality

The fall sluicing would increase turbidity, sediment loading and nitrogen levels as with Alternative 1. The impacts would likely be similar to those in 1976, since stream flow is likely to be at or below 10 cfs for fall sluicing. With normal runoff patterns, the turbidity and sediment loading will violate standards during and after sluicing and will likely increase again later in the winter and in the spring as higher flows move the sediments down Bear Creek.

The movement of sediments is a complex function of sediment size, stream morphology, water velocity and depth, and flow duration. Sediment will move in suspension in the water and as bedload along the bottom of the stream. The higher the flow the greater the carrying capacity of each unit volume of water. Thus, the highest flows carry the vast majority of sediments. Beyond stating this general relationship, no quantification of the sediment-carrying capacity of Ashland or Bear Creeks has been attempted, since the composition by size of the sediments sluiced from Reeder Reservoir is not known, and studies to evaluate sediment transport in Bear Creek are considered by EPA to be beyond the scope of the EIS.

Knowledge of the probability of high flows occurring is of some value to the analysis. Flow duration curves (Figure 4-8) were developed for Bear Creek at Medford, based on USGS gauge records for 1967-1976, illustrating the probability of various flows occurring between November 16 and April 15, by month-long increments.

The probability of flows of at least 500 cfs (an arbitrary "high" flow selected for analysis purposes) is about 2 percent from November 15 to December 16, rising to about 20 percent in January 16 to February 15, and dropping off slightly in March and April. The probability of flows over 500 cfs occurring after the conclusion of fall sluicing (assume December 16) and before April 15 is about a 50 percent chance. In comparison, the chance of spring flows in Bear Creek of greater than 500 cfs between March 15 and April 15 (assuming completion of spring sluicing as of March 15) would be about 15 percent. Thus the likelihood of flows over 500 cfs occurring in Bear Creek prior to April 15 is three times higher following fall sluicing than following spring sluicing. From this it can be reasonably concluded that sediment sluiced from Reeder Reservoir in the fall is more likely to be conveyed through the Bear Creek stream system than sediments sluiced in March.

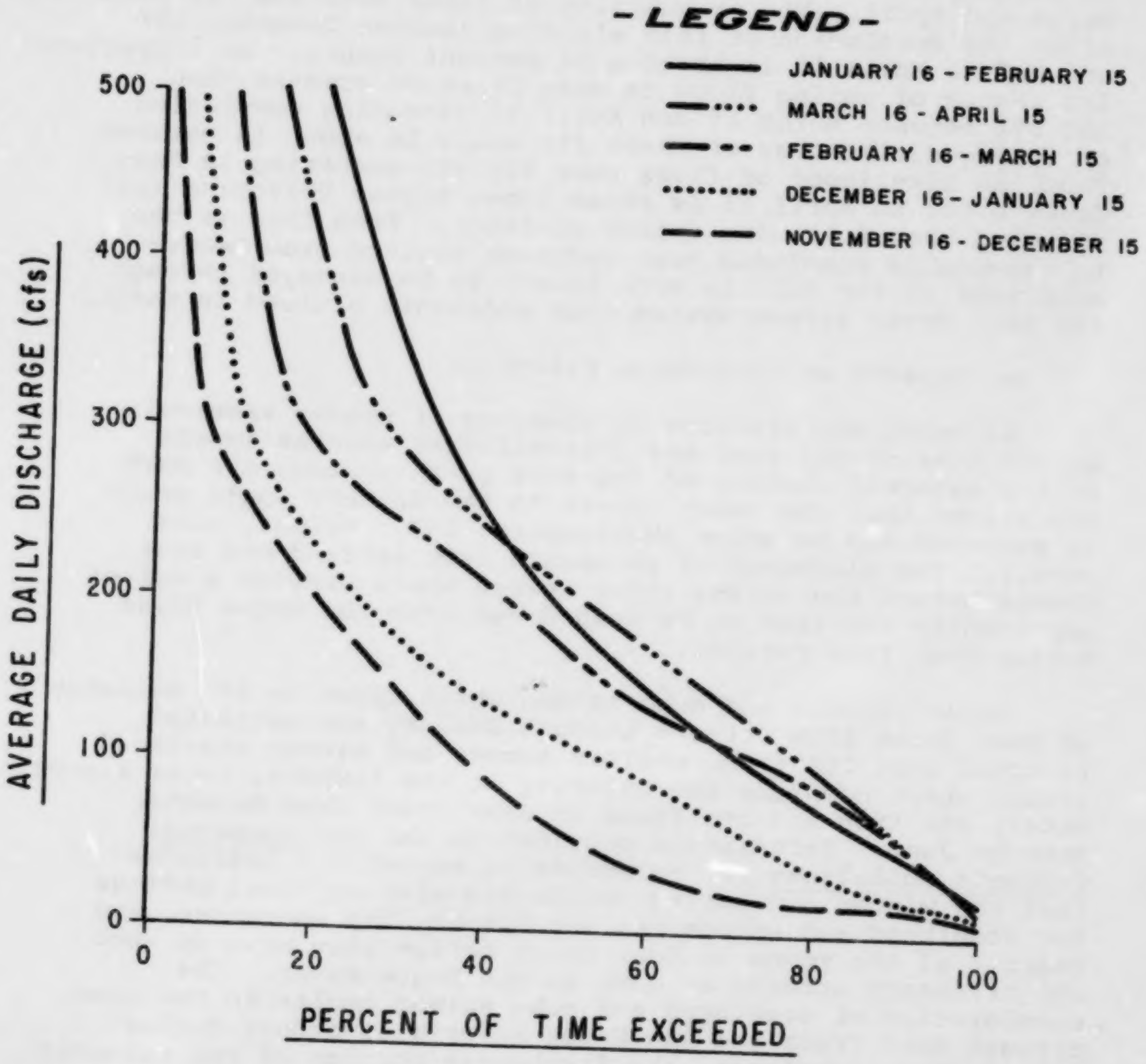
- Impacts on anadromous fisheries

Although the sluicing or dredging of Reeder Reservoir at any time of the year has a significant adverse impact on the salmonid fishery of the Bear Creek system, the ODFW has stated that the least impact to the fishery would occur in November and December (Montgomery, 1977; Haight, pers. comm.). The discharge of sediments into Ashland and Bear Creeks before the winter rainy season would provide a better opportunity for them to be washed out into the Rogue River during peak flow periods.

Adult chinook and coho salmon which spawn in the mainstem of Bear Creek from October through January are estimated to total only 110 fish, whereas summer and winter steelhead trout, which comprise the majority of the fishery, total approximately 850 fish and are found in Bear Creek from December through June. Information provided in the Environmental Criteria Guidelines for salmonids in Appendix D indicates that the winter and spring months are also critical periods for steelhead and salmon egg incubation, fry emergence, and rearing of the young in Bear Creek before they move up into the tributary streams or down to the Rogue River. The outmigration of steelhead and coho salmon smolts to the ocean through Bear Creek and the Rogue River also occurs during this period, completing the freshwater portion of the salmonid reproductive cycle.

FIGURE 4-8

FLOW DURATION CURVES FOR BEAR CREEK AT MEDFORD FOR MONTHLY PERIODS FROM NOVEMBER 16 TO APRIL 15



SOURCE: USGS GAGE 14357500, WATER YEARS 1967-1976

The impacts on the salmonid fishery of sluicing the reservoir during the months of November and December will be similar to those outlined in Alternative 2 for dredging activities during the same period. The discharge of sediments in November and December would have an immediate adverse impact on the inmigration and spawning of adult chinook and coho salmon, and silting of the streambed would degrade or eliminate available spawning gravel areas and smother eggs already spawned by chinook and coho salmon in the mainstem of Bear Creek.

Unless subsequent peak flows during the winter and spring were sufficient to wash the accumulated sediments out of Ashland and Bear Creeks, the silting of the streambed during the fall would also adversely affect the spawning and rearing of the young of both summer and winter steelhead during the winter and spring months due to the loss of appropriate stream gravel habitat.

o Water supply impacts

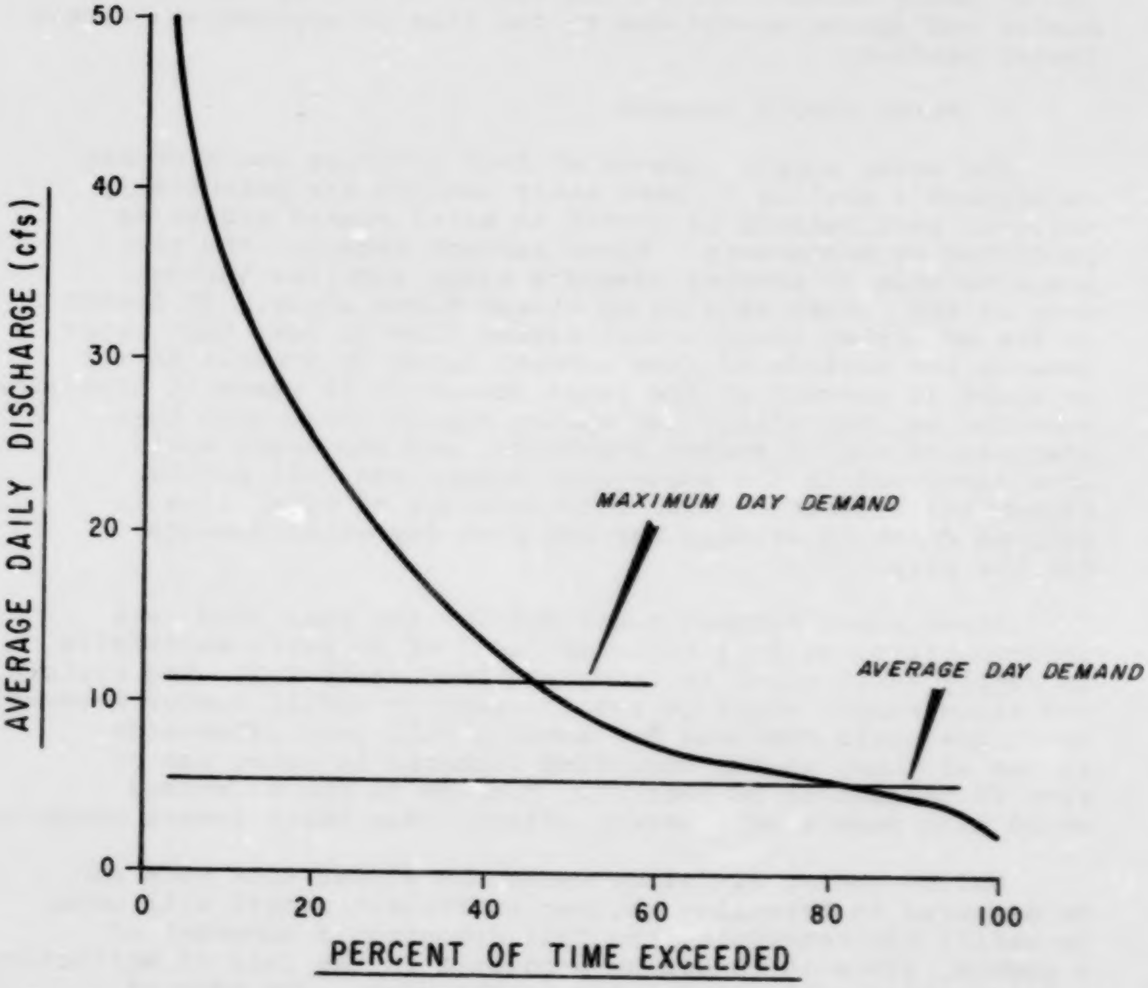
The water supply impacts of fall draining and sluicing on Ashland's ability to meet water demands are potentially serious, particularly if growth in water demand occurs as predicted by Montgomery. Given current demands, the city would be able to provide adequate water supplies through most of the winter relying on stream flows alone. (A freeze in the watershed could reduce stream flow to less than water demands for periods of from several hours to several days.) In about 20 percent of the years (based on 10 years of historical records) neither winter nor spring runoff would have been adequate to refill Reeder Reservoir, and shortages would have developed in the subsequent summer and fall months. Figure 4-9 illustrates the relationships of total flow in Ashland Creek to average day and peak day water demands for the city.

Given water demands projected for the year 2000, and implementation of fall sluicing, in 3 of 10 years shortfalls in supply would occur in December immediately following sluicing, and since runoff would be insufficient to refill Reeder Reservoir, shortages would continue for about a full year afterwards in two of those years, requiring cutbacks in water use of from 25 percent to 50 percent. Freezes in the watershed would also have a more severe effect under these future conditions.

Unlike spring sluicing, where the winter snow pack can be measured to determine whether sufficient runoff will occur to refill the reservoir, the fall draining is somewhat of a gamble, since it cannot be predicted in the fall if sufficient precipitation will occur later in the year. The odds of shortages will increase as water demands increase, if this alternative is implemented.

FIGURE 4-9

FLOW DURATION CURVE FOR
EAST & WEST FORKS ASHLAND CREEK, ANNUAL BASIS, SHOWING RELATIONSHIP TO CITY OF ASHLAND WATER SUPPLY NEEDS[1]



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[1] BASED ON WATER YEARS 1926-32, 1975-77, USING AVERAGE DAILY FLOWS FOR USGS GAGES 14353500 AND 14353000

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Water shortages could result in rationing, high water rates, prohibitions on some uses, and in extreme cases, prohibition of exterior water use. To the extent that fall draining and sluicing reduced storage and aggravated the shortage, dissatisfaction with this management method (and managers) could result. A supplemental water supply of sufficient quantity could totally mitigate this adverse impact. A new reservoir in the Ashland Creek watershed at the Winburn site would provide such a supplemental supply. The intertie with Talent Irrigation District (to be completed in summer 1979) would not completely alleviate such a shortage since the water may only be used for irrigation purposes, and not for municipal (domestic) uses.

o Economic impact

The economic effects of Alternative 3 would be the same as Alternative 1 (manpower and equipment for sluicing plus fisheries loss) plus water revenues lost in dry years when Reeder Reservoir did not refill. In addition to lost revenues, the city might incur added costs from administering and enforcing water conservation programs. Fisheries losses are arbitrarily assumed to be equal to those of Alternative 1, since sluicing in dry years may leave sediments in the stream throughout critical periods.

Lost water sales revenues can be roughly estimated by assuming that Reeder would fail to refill in about one-half of the years, and that in those years it would average one-half full. At $100 per acre-foot retail price, and an average annual water loss of 215 acre-feet (one-quarter of Reeder's capacity), the revenues lost would total about $21,500 per year.

Thus the total annual cost to the city of Alternative 3 would be $45,400 to $47,800 (1977 dollars), plus costs of enforcing water conservation in some years.

Environmental Impacts of Alternative 4 - Draining Reservoir for Entire Season

This alternative would allow the natural regime of Ashland Creek to be more nearly duplicated in winter months, allowing sediments to pass through during high runoff, except that flows after about March 31 would be regulated as the reservoir was filled. The Winburn Reservoir, which it is assumed will be built on the West Fork of Ashland Creek, is to provide the required supplemental water source as part of this alternative, which complicates the analyses. It must also be cleaned and it would comprise a further regulation of Ashland Creek.

o Practical considerations

Montgomery recommends that Winburn Dam be drained and sluiced, since it will receive sediment and debris. Thus, net sediment inflow to Reeder Reservoir would be reduced only to the extent that erosion along the West Fork of Ashland Creek is reduced downstream of Winburn Dam to Reeder Reservoir, and to the extent that any sediments or debris are removed from Winburn Dam by means other than sluicing. The timing of sediment inflow to Reeder Reservoir would be changed, however, and sediments originating in the West Fork during storms could not be passed through the system unless both reservoirs were empty at the same time, an unacceptable approach from a water supply standpoint.

While sediment flows would remain unnaturally high due to prior watershed disturbance, the retention effects of Reeder Reservoir would be reduced by this alternative. However, during peak storm events the volume of sediment and debris would be greatest, and it would likely block the existing outlet. Even with an enlarged sluiceway outlet and improved trash racks, a storm such as occurred in 1974 would likely have plugged the outlet and filled the reservoir. Thus, the effectiveness of this alternative in achieving its stated goal would be limited by the capacity of the reservoir outlet to pass flow, sediment and debris in those few peak events that contribute the majority of the sediments. Without a greatly enlarged outlet, the impacts of this alternative will resemble those of Alternatives 1, 2 or 3.

o Water quality impacts

If all of the sediments could be passed through Reeder Reservoir and not retained, some water quality violations would still occur. Organic material that had settled to the reservoir bottom would cause an increase in downstream nitrogen levels as it was washed through following draining. This effect would probably last only a few days. Turbidity and sediment loading in Ashland and Bear Creeks would be increased following draining and again after each storm in the watershed. Since background levels of turbidity and sediment would be higher in the basin the percent increase would be less than at low flow periods. Bottom deposits would likely continue to form, as high flows in Ashland Creek do not always coincide with high flows in Bear Creek and the sediments can easily settle out in the flatter streambed of Bear Creek.

- Anadromous fisheries

Since this alternative would permit more nearly natural stream flow and sediment discharge to occur during the rainy season, its effect on salmonid production within the Bear Creek system would depend on the timing of storms relative to fish life cycles. Under natural stream flow conditions peak suspended sediment and turbidity conditions similar to those created by sluicing would be likely to occur less often, and for shorter periods, coinciding with high stream flow. The natural stream flow conditions would also help to scour the stream gravels in Ashland and Bear Creeks, improving the quality of the salmonid habitat in the Bear Creek system. However, adverse effects of high sediment yields in the watershed would continue to have adverse impacts on fisheries.

- Water supply effects

Draining Reeder Reservoir for the entire season combines the gamble of insufficient winter runoff with the chance of insufficient spring runoff, maximizing the chances that a shortage will arise in the summer. The risk of fall freezes also exists. The supplemental water supply that would be provided by the Winburn project becomes a necessity in this alternative.

The analyses of Montgomery (1977) indicate that a reservoir at the Winburn site would have to be drained and sluiced, as would Reeder Reservoir. The phasing of these actions would have to be studied to ensure that a conjunctive operation would be worked out that would not risk shortages in the combined water supply.

- Flood protection

Even when full, Reeder Reservoir will moderate flood flows to some degree. When empty, it will retain that portion of inflow that exceeds the outlet capacity until the spillway overflows. Thus, the presence of an empty reservoir during the winter months provides an added flood control benefit, increasing protection for the City of Ashland. In 1974 for instance, the peak flow of 1,330 cfs over the dam might have been less if Reeder had been empty, and downstream damage might have been less.

- Economic impact

The economic effects of Alternative 4 are primarily the costs of amortizing a new water supply (Winburn Reservoir on the North Fork of Ashland Creek) plus manpower and equipment for keeping the outlet to Reeder Reservoir cleared and for sluicing Winburn Reservoir plus fishery losses. Montgomery indicates the cost of Winburn Reservoir as $5,130,000 with the city's share being $3,172,000 (1977 dollars). Costs to the city amortized over 40 years (Winburn Dam, 20 years for the pipeline, both at 6 percent interest) would total $182,000 per year. Maintenance and operation were estimated at $17,500 per year. The costs for sluicing Winburn and keeping the Reeder outlet clear of debris may be greater than at present, but are assumed for purposes of this EIS to be the same. Fishery losses would be less than for other alternatives, but still would occur due to the unnaturally great sediment volumes. No quantification of these losses is attempted.

Total annual costs for Alternative 4 would equal about $209,000 plus undetermined fisheries losses.

Environmental Impacts of Cleaning Following Catastrophic Sediment Inflows

As defined in Chapter 2 herein, a catastrophic event is one which obstructs the water supply outlet or which obstructs the sluiceway outlet and requires special efforts, other than draining and sluicing, to reopen it.

The cleaning of Reeder Reservoir following major sediment-carrying floods has required special action by the City of Ashland in past years. In 1964 and again in 1974 the normal cleaning techniques became unworkable due to the volume of sediments deposited in the reservoir. These events required special actions, including dredging after the start of the irrigation season. A requirement for such untimely cleaning could conceivably occur again if a large sediment inflow blocks the sluiceway outlet or threatens to block the water supply intake. Under such conditions the city may conclude that at least some of the accumulated sediment must be removed before the next fall, to avoid the risk of complete loss of the intake in subsequent floods.

The analysis of impacts following catastrophic inflows is essentially a documentation of the more serious adverse impacts that occurred after the 1974 dredging, which began in late May and ended in early July.

- Water quality impacts of cleaning following catastrophic sediment inflows

The water quality impacts of the proposed dredging of Reeder Reservoir during high stream flows may be estimated using information provided in the USFS report, Water Quality in Ashland and Bear Creeks, Jackson County, Oregon, During and After Sediment Removal from Reeder Reservoir (Weaver, 1974). In their study of the cleaning of Reeder Reservoir during the summer of 1974 the USFS monitored turbidity, water temperature, and concentrations of dissolved solids at eight stations, four each on Ashland and Bear Creeks. The USFS concluded that of the three parameters measured, turbidity was the only one which was significantly affected by the discharge of sediments from Reeder Reservoir.

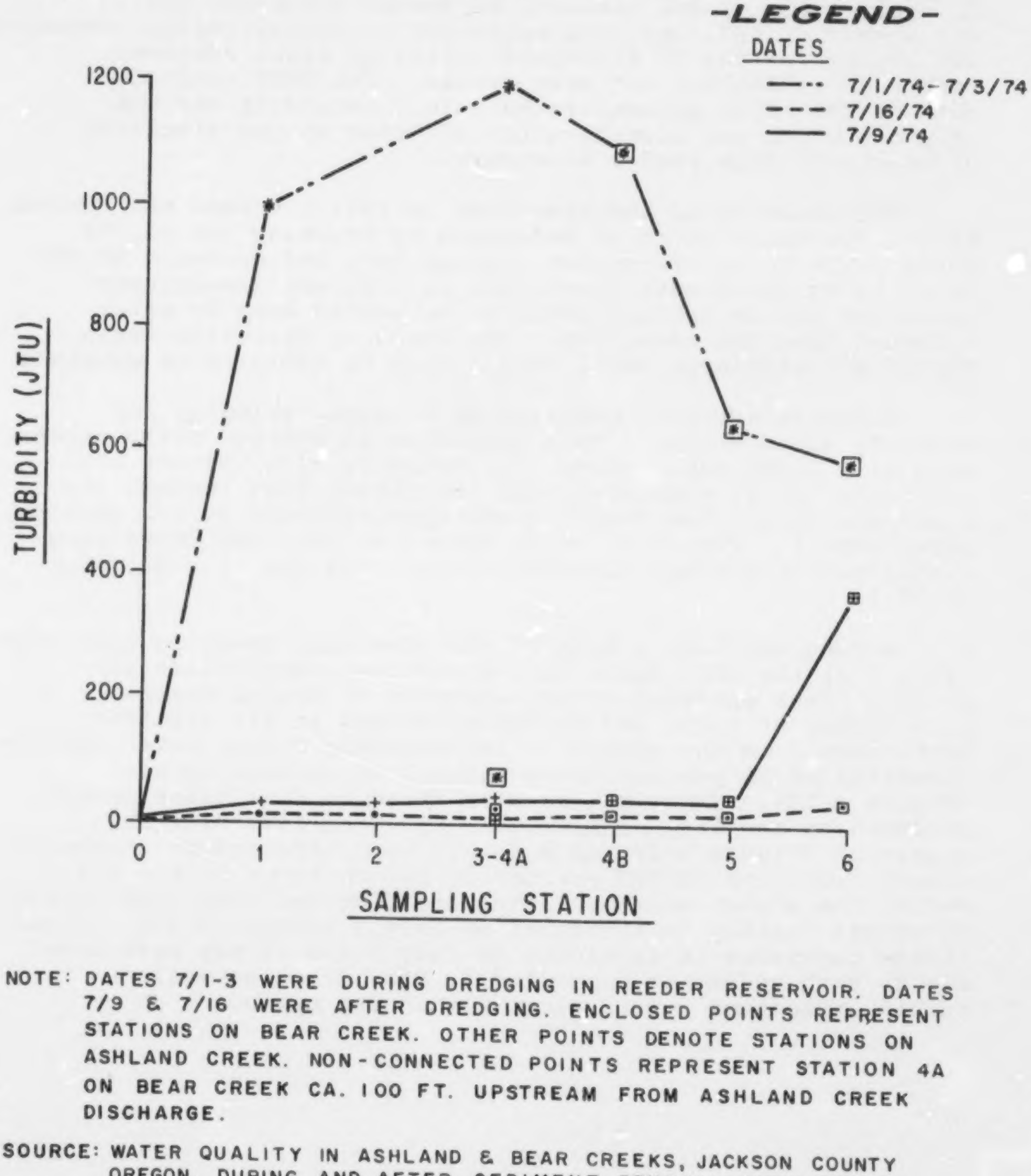
The cleaning of the reservoir in 1974 involved the removal of 122,000 cubic yards of sediments by trucking out 62,000 cubic yards to an off-stream storage area and dredging 60,000 cubic yards which were discharged as a slurry immediately below the dam in Ashland Creek to be washed away by water released from the reservoir. The dredging operation began May 28 and continued until July 3 with no dredging on weekends.

Dredging actually occurred on 21 days, allowing for weekends and downtime. This indicates an average daily discharge of nearly 2,900 cubic yards. Although no flow records are available, it is estimated that the stream flow through the reservoir during the dredging was approximately 50 cfs (Fallon, pers. comm.). From this it is estimated that sediments were discharged at average concentrations of 18 ppt or a dilution of 56:1.

During the last 3 days of the reservoir dredging operation (July 1-3) the USFS found that downstream turbidities in Ashland Creek exceeded values upstream of Reeder Reservoir by a factor of 1,000 and turbidity values at all stations downstream from the reservoir far exceeded Oregon water quality standards of 10 percent above natural background levels (Figure 4-10). These values were three to four times those recorded by the City of Ashland during the 1976 sluicing operation (Figure 4-6) and may have been affected by increased stream flows and turbid irrigation return flows in the basin during the summer months. After dredging was completed turbidity decreased rapidly as indicated on July 9 (Figure 4-10). Downstream increases in turbidity on July 9 and 16 may have been due to both sediments deposited in Bear Creek as well as turbid irrigation return flows within the basin.

FIGURE 4-10

TURBIDITY PROFILES FOR ASHLAND & BEAR CREEKS



NOTE: DATES 7/1-3 WERE DURING DREDGING IN REEDER RESERVOIR. DATES 7/9 & 7/16 WERE AFTER DREDGING. ENCLOSED POINTS REPRESENT STATIONS ON BEAR CREEK. OTHER POINTS DENOTE STATIONS ON ASHLAND CREEK. NON-CONNECTED POINTS REPRESENT STATION 4A ON BEAR CREEK CA. 100 FT. UPSTREAM FROM ASHLAND CREEK DISCHARGE.

SOURCE: WATER QUALITY IN ASHLAND & BEAR CREEKS, JACKSON COUNTY OREGON, DURING AND AFTER SEDIMENT REMOVAL FROM REEDER RESERVOIR. (WEAVER, 1974)

JONES & STOKES ASSOCIATES, INC.

According to the USFS (Weaver, 1974) "the recorded increases (in turbidity) were aesthetically displeasing, prevented normal use of water, and undoubtedly caused serious damage to the indigenous biota." Numerous silt, sand and gravel bars were formed in Ashland and Bear Creeks from sediments discharged from the reservoir, and were later subject to erosion, causing turbidity problems during increased fall and winter flows (Weaver, 1974). This same delayed effect on stream turbidity and suspended sediment levels was indicated by data presented in Figure 4-2 describing the effects of the sluicing of Reeder Reservoir on downstream water quality.

The RVCOG's water quality data for the Bear Creek Basin, collected during the 1976 sluicing of the reservoir, indicate that sluiced sediments cause a significant increase in organic nitrogen levels in Ashland and Bear Creeks during cleaning operations. It is likely that a similar increase would result from dredged sediments.

- Fisheries impacts of cleaning following catastrophic sediment inflows

The effects of the 1974 summer dredging of Reeder Reservoir on the salmonid fisheries of Bear Creek were described by the ODFW in its Upper Rogue District Monthly Report, August 1974. The bed of Bear Creek from its confluence with Ashland Creek to the Medford area was found to be covered with decomposed granite, and steelhead fry as well as most species of aquatic insects on which they feed were found to be absent. Field sampling by the ODFW indicated that virtually all of the fall chinook and winter steelhead spawn was lost due to the sediment released from Reeder Reservoir, and that summer steelhead fry, spawned in the tributary streams, survived long enough to reach Bear Creek during their outmigration in the spring but died after they entered Bear Creek (Jennings, pers. comm.). The combined effects of the reservoir cleaning operation on both adult spawning and survival of the young resulted in the elimination of all salmonid production within the Bear Creek system for the year 1974-1975, causing an estimated one-year economic loss of $67,468 (Jennings, pers. comm.). No damage monitoring or loss estimates were developed for subsequent years.

- Impact of cleaning following catastrophic sediment inflows on irrigation users

The dredging of Reeder Reservoir from late May to early July in 1974 interfered with irrigation diversions from Bear Creek below the confluence with Ashland Creek. Sediment blocked diversion dams, silted sections of irrigation canals and blocked pumps.

The Medford Irrigation District reported that their diversion dam was repeatedly silted in during the 1974 dredging. On several occasions the district removed flashboards on the dam and used mechanical equipment to pass accumulated sediment debris and tree bark downstream. The sediment reportedly abraded and destroyed the fish screens protecting their diversion, and left substantial deposits of sediment in their canals, which had to be removed with a Gradall. A diversion pump on Bear Creek at Phoenix also kept getting clogged, and had to be cleaned frequently. The district indicated that this was the only time in recent memory that such problems have arisen. No cost estimates were made of the clean-up required (Ralph Kime, pers. comm.).

The TID diverts most of their water from Bear Creek upstream from the confluence with Ashland Creek. They did confirm that silt problems in Bear Creek in 1974 were substantial, and that Medford Irrigation District, Rogue River Valley Irrigation District and Bear Creek Orchards all had problems. TID indicated no costs to the district for sediment removal in 1974 (Dee Swaringen, pers. comm.).

Bear Creek Orchards indicated some problems with pumps clogged by silt in 1974.

One individual filed a court action against the city alleging the silt interfered with his irrigation pump in Bear Creek, but this was settled without ever going to trial (Fallon, pers, comm.).

o Other impacts of cleaning following catastrophic sediment inflows

The 1974 dredging had other effects, most notably channel silting on lower Ashland Creek. The high sediment load of Ashland Creek and the flatter stream gradient near the Bear Creek confluence led to deposition of dredged sediments in the creek bed. As a result, flows broke out of the Ashland Creek channel, flooding and depositing silt and debris across a rural residential area adjacent to Bear Creek.

The beneficial effect of sediment removal was to substantially reduce the risk that subsequent sediment inflows would block the water supply intake at Reeder Reservoir. It also enabled the city to eventually drain and sluice the remaining sediments from the reservoir. Without dredging, it may have been impossible to reopen the sluiceway outlet.

In addition to dredging, debris and sediment were removed from Reeder Reservoir in 1974 by dragline and truck. This removal cost an estimated $5.50 for each of the 62,000 cy involved, for a total of about $340,000. The dredging was also quite costly. Part of the removal costs were borne by the Corps of Engineers under their emergency work authorization by Congress. Energy and manpower were also used by the cleaning.

Dust and vehicle emissions resulted from hauling and smoke resulted from burning debris within and adjacent to the reservoir.

Chapter 5

IDENTIFICATION OF EPA PREFERRED ALTERNATIVE

As discussed in Chapter 1, the proposed EPA action analyzed in this EIS is approval of one element of the Rogue Valley Council of Governments' Areawide Water Quality Management Plan. This element deals specifically with sediment removal from Reeder Reservoir. The Water Quality Management Plan previously identified discharge of removed sediments to Ashland Creek as the only practical approach. Recognizing that reservoir sediment originates in the Ashland Creek watershed, and that control of sediment production from the watershed is of primary importance, a separate element of the Water Quality Management Plan addressed watershed management by the U. S. Forest Service. That plan element, calling for a memorandum of agreement between the Forest Service and the City of Ashland, preparation of a long-term watershed management plan by the Forest Service, and implementation of an interim watershed plan, has already been approved by EPA. The present decision, then, is limited to questions of method and timing of sediment discharge from Reeder Reservoir to Ashland Creek.

Evaluation of Alternatives

Alternative 1, spring draining and sluicing, would release sediment during February or March in years of high snow accumulation and runoff. This coincides with critical periods for anadromous fish, with severity of impacts generally dependent on how soon peak runoff occurs following sluicing. This is the established cleaning method, which virtually ensures adequate reservoir filling after sluicing. Annual costs are estimated at $23,900 to $26,300.

Alternative 2, sediment dredging during periods of "high flow" with discharge to Ashland Creek, would release sediments periodically during periods of higher than medium flow, which is most likely from January through March. Although this coincides with critical periods for anadromous fish, impacts and water quality standards violations would be reduced by relatively higher stream flows. Although dredging does not require reservoir draining, draining and sluicing as in Alternative 1 would probably still be required every several years. Dredging during high stream flows could be dangerous to equipment operators. Annual costs are estimated at $50,200.

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Alternative 3, fall draining and sluicing, would release sediment in November or December. This timing would result in a better chance that, during wet years, sediment could be flushed through the Bear Creek system prior to critical periods for fisheries. However, in dry years discharged sediments might not be flushed at all. Prior to winter snowpack accumulation, dry years could not be predicted. Unpredictable dry years would also prevent adequate reservoir refill in about 20 percent of the years, causing summer water shortages for the City of Ashland. Annual costs are estimated at $45,400 to $47,800. The uncertain fisheries benefits of this alternative do not appear to outweigh the serious risks of water supply shortages. This alternative is therefore not considered acceptable.

Alternative 4, fall draining with the dam sluiceway open all winter, assumes an independent decision by the city to construct a new water supply dam at the Winburn site. During periods of moderate flow, sediment discharge would approximate natural conditions. Due to limited sluiceway capacity, sediment carried by very high flows would be deposited in the reservoir necessitating later removal by one of the previous methods. Water supply shortages would be prevented by the new reservoir, from which sediment would also have to be periodically removed. Including dam construction, annual cost is estimated at $209,000. Although the City of Ashland may need to find an additional water supply within the next decade, expansion of sediment removal options cannot realistically be expected to be the key factor in this water supply decision. This alternative is therefore not preferrable at this time. However, as the city considers future water supply alternatives, the advantages of sediment removal flexibility should be explicitly counted as an important benefit.

EPA Preferred Alternatives

The Rogue Valley COG's Water Quality Management Plan recommended dredging, as in Alternative 2, as the preferred sediment removal method. At this time, the City of Ashland favors a continuation of spring sluicing as in Alternative 1. This EIS has been unable to conclude that environmental impacts of one of these two alternatives would be clearly preferrable to the other. Neither does the issue of assurance of water supply lead to sharp distinctions between these alternatives. Considerations of cost and practicality do tend to indicate Alternative 1 as preferrable. EPA therefore proposes to conditionally approve the Reeder Reservoir element of the Rogue Valley Water Quality Management Plan with the stipulation that either Alternative 1 or 2 is acceptable. The final decision on which of these two alternatives to implement will be left to Rogue Valley COG in consultation with the City of Ashland, which will act as the management agency. The conditions for EPA approval, which have been agreed to by RVCOG, are discussed below.

Environmental Mitigation

The analysis of environmental impacts indicates that, regardless of the reservoir cleaning method selected and its timing, downstream impacts on fisheries and irrigation and state water quality standards violations would occur periodically. The most important means of mitigating these adverse environmental impacts is to control sediment production from the Ashland watershed. This problem is addressed in a separate element of the Rogue Valley Water Quality Management Plan and is not specifically part of the present decision. Additional mitigation will be accomplished through the following agreements between RVCOG and EPA, which were discussed at the May 13, 1980 Annual Review of the RVCOG continuing planning process, and have been agreed to by the City of Ashland. These agreements will be incorporated into EPA approval of the Reeder Reservoir element of the Water Quality Management Plan.

1. Rogue Valley Council of Governments shall obtain a written commitment from the City of Ashland to construct modifications to the water supply intake at Reeder Reservoir to provide inlets at additional elevations in the reservoir as recommended by the 1977 Montgomery study. The commitment shall include a time schedule for implementation of this condition and a program to monitor compliance.

2. Rogue Valley Council of Governments shall obtain a written commitment from the City of Ashland to undertake an engineering feasibility study of an enlarged sluiceway as recommended by the 1977 Montgomery study. The city should agree to construct this dam modification should the study indicate that it is feasible. The commitment shall include a time schedule for implementation of this condition and a program to monitor compliance.

3. Rogue Valley Council of Governments should secure a commitment from the City of Ashland, consistent with the requirements of the Department of Environmental Quality waste discharge permit, to conduct monitoring of discharges from Reeder Reservoir and Ashland Creek water quality.

Additional Recommendations

1. The 1977 report by Montgomery Engineers recommended that the City of Ashland augment its water supply by constructing a new water supply dam at the Winburn site on the west fork of Ashland Creek. This EIS has shown

that if such a dam were in place, the possibility of using its impounded water as a supply source for the city during the winter months would permit leaving the Reeder Reservoir sluiceway open all winter, thus returning stream flow and sediment transport conditions to a more natural state, with presumably lower impacts. EPA recommends that these potential fisheries benefits be explicitly considered in any evaluation by the city of costs and benefits of the proposed new dam or other supplemental water supply options. These would, of course, need to be balanced by adverse fisheries impacts of dam construction, if that were the preferred new supply option.

2. If, as a result of monitoring of dredging or sluicing operations by the City of Ashland or other agencies, it becomes apparent at a future time that neither watershed management efforts nor reservoir maintenance operations are preventing continued substantial adverse impacts on downstream water quality, fisheries, and other values, EPA recommends that the RVCOG retain the option of considering sediment removal from the stream system as a possible control solution. The Montgomery report and this EIS identified downstream settling ponds as the most feasible of the sediment removal alternatives. EPA believes the Montgomery Report may have overestimated the land acquisition requirements, thereby prematurely removing this alternative from consideration. Further evaluation of this approach should be undertaken if serious fishery problems continue. This should be discussed during future annual reviews of the RVCOG continuing planning process.

3. A major problem in all alternatives is the assurance of high enough stream flows following dredging or sluicing to carry sediments through Ashland and Bear Creeks. High flushing flows would be most beneficial in late winter to early spring, during the normal high flow period. The Bureau of Reclamation has been studying the possibilities of providing flow augmentation in Bear Creek, which may enhance water quality and fisheries values. The bureau is presently considering augmentation only during the summer irrigation season. EPA recommends that the RVCOG and the Oregon Department of Environmental Quality work with the Bureau of Reclamation to determine the possibility of incorporating fishery enhancement, through sediment flushing, into the bureau study process.

Unavoidable Adverse Impacts

The recommended dam outlet modifications have the following unavoidable adverse impacts.

Water Supply Intake Modifications

- Minor construction impacts, lasting 1 to 2 months, including dust, exhaust emissions and exposure of construction workers to safety hazards.

Sluiceway Outlet Modifications

- Minor construction impacts, lasting several months, including dust, exhaust emissions and exposure of construction workers to safety hazards.
- Possibility of water shortages for city residents during and following construction, unless a temporary supplemental water supply can be located

Local Short-Term Uses of the Environment vs. Maintenance and Enhancement of Long-Term Productivity

The harvesting of timber and other recent watershed uses have compromised the water supply purpose of the Ashland watershed. In retrospect the disruptions constitute an unwise short-term use of the watershed lands at the expense of maintenance and enhancement of the water supply use of the watershed. It is hoped that new USFS management policies will correct this unwise use in favor of protection and enhancement of the water supply uses of the watershed.

Given the sediment production of the watershed, which is expected to continue as a result of past disturbances, the decision that is under consideration involves passing the sediments through the reservoir at the least disruptive time and in the least disruptive way, consistent with constraints on the city's water supply. The relationship of these discharges on the productivity of Bear Creek in terms of fisheries and other beneficial uses is not well understood at present. Similarly, it is not known if the much more costly alternatives that involve completely removing these sediments from the stream system would lead to better maintenance and productivity of Bear Creek.

The modifications of the Reeder Reservoir water supply intake and sluiceway outlet will improve the utility of the reservoir for water supply purposes, will improve its protection from operational dysfunctions as a result of major sediment inflows, and will enable greater environmental protection of downstream beneficial uses. The short-term construction impacts and the construction costs (about $215,000) would be the trade-offs for the resulting long-term benefits.

Irreversible and Irretrievable Commitments of Resources

Minor commitments of construction materials, labor and capital funds will be necessary to modify the outlets to Reeder Reservoir. Following completion, the commitments of energy and manpower to clean the reservoir should be reduced.

Chapter 6

ISSUES NOT RESOLVED BY THIS ACTION

Water quality management issues in the Bear Creek watershed are larger in scope than the question of cleaning methods for Reeder Reservoir and thus, not resolved in this EIS. However, recognizing that the decision resulting from this EIS concerning the reservoir is related to the larger water quality issues, several commentors have raised questions about these larger issues, either in written comments or at the public hearing (see Chapter 7, COORDINATION). In some cases these issues can be resolved by EPA or other agencies in separate decisions. In other cases, issue resolution is due to lack of information. The following are the major unresolved issues related to the decision in this EIS.

Sediment Carrying Capacity

As discussed in the text, the sediment carrying capacity of Ashland Creek and Bear Creek is a complex function of sediment size, stream morphology, water velocity and depth, and flow duration. Quantitative determination of these relationships was considered by EPA to be beyond the scope of this EIS. Further, some of the data required to perform such an analysis, particularly the size distribution of the sediments, are lacking.

As a result, analyses of how long sediments remain in Ashland and Bear Creeks, what flow volumes are necessary to move sediments on through the Rogue River, and estimates of how much sediment can be handled by the streams without environmental damage or water quality violations at selected flow volumes have not been possible.

If sediment transport relationships were known, it would be possible to compute the rate of sediment movement through Bear Creek as a result of various reservoir cleaning alternatives under varying hydrologic conditions in Bear Creek. It is conceivable that such analyses might reveal more clear-cut differences between alternatives in their impact on beneficial uses of Bear Creek.

The City of Ashland has recommended that additional monitoring be done to learn more about stream flow and sediment movement, the role of channel erosion, and surface erosion from roads, logged areas, and the Ashland ski area. EPA would encourage appropriate agencies to develop whatever additional data are necessary to accurately predict sediment delivery, storage, and transport in Ashland and Bear Creeks. See response to comments from Mr. Al Alsing in Chapter 7.

Relative Importance of Ashland Creek as a Sediment Contributor to Bear Creek

An issue that remains unresolved is the relative importance of Ashland Creek as a contributor of sediments to Bear Creek. While Montgomery (1977) has estimated quantities discharged to the Bear Creek system from Reeder Reservoir on Ashland Creek, no similar estimates exist for other tributaries or for the total sediments in Bear Creek. The Ashland Creek contribution has been most visible because its timing has not coincided with the flood flows that move sediment on the other tributaries. In particular, dredging operations in 1974 extended well into the irrigation season, conveying sediment to downstream beneficial users at a time when the streams generally run clear.

It is known that Neil Creek drains some areas of granitic soils in the Ashland stock batholith, and that it is a contributor of sediment (see Figure 2-2 and Table 2-5). Other tributaries drain generally nongranitic soils, but do contribute some sediment. In judging the total impact of Reeder Reservoir cleaning upon the Bear Creek system, it would be useful to estimate the total combined magnitude of all sediment sources in order to identify in greater depth what problems with fisheries, channel aggradation, and conflicts with other beneficial uses are traceable to sediment contributions originating in the Ashland watershed as opposed to other sources, and to develop a management program to mitigate the adverse effects throughout the basin.

Such an analysis might indicate that sediments from Ashland watershed do not provide a substantial proportion of total sediments in Bear Creek and that the four viable alternatives provide environmentally appropriate cleaning options; alternatively, such an analysis might indicate Ashland Creek does contribute a significant proportion, and that further actions to reduce sediment yield or prevent the material from reaching Bear Creek require investigation.

Quantification of Fisheries Impacts Due to Sedimentation

At present the evidence is insufficient to quantitatively indicate whether sediments from Ashland Creek are a significant detriment to the anadromous fishery or merely one important factor among many. The degradation of the anadromous fishery is certainly the result of many watershed uses, only one of which is the maintenance of Reeder Reservoir. Changed habitat due to higher summer and early fall flows, agricultural cultivation and return flows, diversion structures, impoundments on tributaries, and urbanization all have adverse effects on the salmonid fishes. Intensive field investigation would be required to proportionately relate watershed uses to causes for impairment of the fishery.

Because of this, the EIS has focused on alternatives that merely adjust the method and timing of discharges from the reservoir. It is possible that the overall impact of Ashland watershed sediments on the Bear Creek salmonid fishery, regardless of discharge timing, is significantly adverse. If this were found to be true, then the alternatives evaluated herein might not adequately mitigate the long-term adverse impacts on Bear Creek. If the impact of the Ashland watershed is not a major factor, then the amount of mitigation recommended as a result of this EIS is appropriate.

Management of Ashland Watershed

This EIS recognizes that Reeder Reservoir merely stores sediment which originates in the Ashland watershed. Several commentors on the Draft EIS expressed interest in U. S. Forest Service management of the Ashland watershed in relation to sediment cleaning from Reeder Reservoir (see Chapter 7). Although watershed management is not specifically part of the decision covered by this EIS, EPA has been concerned with that issue through the overall Rogue Valley COG Water Quality Management Plan. In January 1979, EPA approved the Ashland watershed element of the Water Quality Management Plan with the condition that RVCOG would work with the Forest Service to ensure that an interim plan for watershed management be adopted by the Forest Service and the City of Ashland, and that a long-term plan be completed by the Forest Service by 1982. In December 1979 an interim plan was signed by the Forest Service and the City of Ashland and adopted by RVCOG. Basically the interim plan continues the previous moratorium on road construction and timber harvest in the Ashland watershed, with certain exceptions in the event of natural catastrophe, and contains a listing of significant problems, issues, and concerns to be addressed in the long-term plan. The city's adoption of the plan was conditioned on Forest Service recognition of certain major city concerns related to the role of human activities in the production of sediment from the watershed, and the process to be used to develop the long-term plan. The city and the Forest Service have not reached agreement on several important issues related to Ashland watershed management, and resolution of these issues has been established as an objective of the long-term plan. The long-term plan will be incorporated into the Rogue River National Forest's overall forest plan, a comprehensive forestwide planning effort scheduled for completion in 1983.

In adopting the interim plan, the RVCOG requested that EPA release it from further commitments to develop further intergovernmental agreements between the City of Ashland and the Forest Service, based on the conclusion that RVCOG had done everything within its power to complete such agreements. This request was discussed at the annual review of the RVCOG continuing planning process in May 1980. The formal procedure would be for the Oregon Department of Environmental Quality to "dedesignate" the RVCOG as the planning agency for the Ashland watershed. Responsibility would revert to DEQ as the overall water quality planning agency for silviculture statewide. A memorandum of understanding is already in place between DEQ and the Forest Service. The Forest Service would remain the designated management agency for water quality management on national forest land including Ashland watershed. Ashland watershed would be identified by DEQ as a problem area to be given priority in their continuing planning process.

Recognizing the importance of detailed resource information in developing the Ashland watershed portion of the 1983 Forest Plan, EPA and the Rogue River National Forest considered the desirability of EPA providing funding to the Forest Service, under Section 208, for gathering inventory data in the watershed. However, it was concluded that the administrative requirements of the 208 process would divert resources and time which would best be applied to the planning effort itself. In a March 1980 letter to the Forest Service Regional Forester, EPA stated this conclusion and encouraged the Forest Service to assure that the City of Ashland will have ample involvement in the watershed planning process and that the city's legitimate water supply concerns will be accommodated.

As part of their 1983 Forest Planning process, the Rogue River National Forest will prepare an environmental impact statement. EPA, the City of Ashland, and other interested parties will have several opportunities to contribute to that EIS process. The Forest Service has distributed several brochures describing the initial planning stages and soliciting public involvement. EPA submitted comments stating its position that future land disturbing activities in the Ashland watershed be undertaken only where it has been conclusively demonstrated that such activities would not degrade water quality. The Forest Service has proposed as one decision criteria for forest planning that management activities will not be allowed to increase sedimentation or contamination in the Ashland watershed beyond natural levels.

Chapter 7

COORDINATION

The EIS process was initiated in May 1978, with a meeting at the city offices in Ashland to discuss Reeder Reservoir and the preparation of the EIS. Attendees at this and subsequent meetings included representatives of EPA, RVCOG, the City of Ashland, USFS, Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality, EPA's EIS consultation, Jones & Stokes Associates, Inc., local citizens, and media representatives. Meetings were held again in Ashland on August 29, and October 16, 1978. A workshop was held at city offices in Ashland on January 16, 1979 to discuss the alternative cleaning methods that had been developed. A workshop discussion of the preliminary evaluation results were held in Medford on April 20, 1979. In July 1979, about 60 copies of the Draft EIS were sent to interested agencies, organizations, and citizens. A formal public hearing was held at Ashland High School on August 23, 1979. That hearing is summarized below. Twelve written comment letters on the Draft EIS were received. There are presented and responded to below. Further public comment will be accepted for 30 days following publication of this Final EIS. EPA's decision will become final after that 30-day period.

Public Hearing Summary

The public hearing was held by EPA at Ashland High School on August 23, 1979. About 25 persons attended. Presentations were made by representatives of EPA and its EIS consultant, Jones & Stokes Associates, Inc. Formal written statements were submitted by Al Alsing of the City of Ashland, H. Tom Davis of Montgomery Engineers, and a citizen, Paul Dokey. These statements and responses are included in the written comments below.

A number of meeting attendees made statements or asked questions. These are summarized here:

Mr. Don Kreitner addressed the need for monitoring of Forest Service sediment reduction efforts, asked whether the Forest Service might bear some of the economic burden of mitigating adverse effects of sediment, and pointed out the need for sediment removal from any additional reservoir at the Winburn site as assumed in Alternative 4.

Mr. John Billings discussed past and present water resource issues in the Bear Creek area. He supported efforts by the City of Ashland to provide water from Reeder Reservoir and suggested that pollution problems in Bear Creek not be blamed on Ashland. He supported sluicing of the reservoir.

Mr. Harvey Seeley, a former Forest Service employee, supported fire control efforts in the watershed, including controlled burning and timber management, and held that timber harvest is now feasible without roads. He also raised the question of construction impacts of the hypothetical second dam in Alternative 4, and said that this may be unacceptable.

Mr. Jim Selleck asked Mr. Alsing about possible herbicide spray contamination of the Ashland water supply. Mr. Alsing said that testing of drinking water was required by law and that no such contamination had been detected, and that no spraying had taken place in the Ashland watershed.

Mr. Ed. Fallon of the City of Ashland asked if the siltation problem at the City of Talent water supply intake was a water quality problem or an engineering problem. Mr. Moreland Smith of the City of Talent indicated that actions were being taken to correct their problem.

Mr. Ed Webber of the Soil Conservation Service asked Mr. Davis if the Montergomery report quantified the degree to which human-caused sedimentation could be reduced by land treatment measures. Mr. Davis indicated this was beyond the scope of the report.

Responses to Comments Received at Public Hearing

Responses to Comments from Don Kreitner

At the public hearing Mr. Kreitner suggested that the USFS efforts to reduce sediment be monitored.

Quantities of sediment can be effectively monitored only as they are removed from Reeder Reservoir, or by soundings taken throughout the reservoir. A major storm event can, within several days, result in a significant sediment inflow under conditions that do not lend themselves to access to the watershed, much less systematic monitoring. Thus, the only measure of effectiveness is likely to be the results of a major storm.

As to monitoring the activities of the USFS, the City of Ashland does maintain coordination with the USFS and is aware of their management of the watershed. The management is currently being discussed between the city and the USFS, in hopes of reaching an agreement on specific actions.

Mr. Kreitner also raises the question of riparian laws as they may apply to downstream damages related to watershed disturbances. The roles of the USFS in managing the watershed and the city in managing Reeder Reservoir create complex legal questions that only a court could properly resolve. To date it is believed that no damage suits related to the sediment have ever been tried. There have been no proposals to date to require the USFS to compensate downstream users for losses, or to share in any such compensations. The costs have always been borne by the affected agencies, except that the City of Ashland did receive federal assistance following the 1974 flood.

Mr. Kreitner raises several questions about the proposed Winburn Dam, its impacts on the watershed, and its own potential sediment buildup.

In response, it is appropriate to point out that Alternative 4 without a new water supply source, would have an unacceptable impact on the city's water supply. In order to overcome this problem and expand the range of alternatives for analysis it was decided to assume that an added water supply would be available. The specific proposal of Montgomery Engineers to construct a new reservoir at the Winburn site was used to make the alternative complete. However, it was not the intent of the EIS to evaluate this feature of the alternative. As Mr. Kreitner points out, construction of such a major facility would have a substantial impact on soils, vegetation, wildlife and water quality. A significant increase in sediment production could be triggered by the disturbance of soils for construction. In addition, as the EIS and Mr. Kreitner point out, Winburn Dam would retain sediments and would require cleaning. The interrelationships between these reservoirs, the city's water supply and cleaning schedules are not yet defined, but surely will be complex as suggested by Mr. Kreitner, and are beyond the scope of this EIS. Likewise a detailed evaluation of the impacts of Winburn Dam is beyond the scope of this EIS.

Responses to Comments from Harvey Seeley

Mr. Seeley comments on fire prevention methods involving timber harvesting and controlled burning. The EIS does not attempt to explore in depth each element of watershed management or to recommend specific management methods. The City of Ashland and the USFS need to agree upon those management methods which will best protect the city's water supply, and protect downstream beneficial uses in Ashland and Bear Creeks.

Written Comments on Draft EIS

All written comments either mailed to EPA or formally presented at the public hearing are reproduced below, followed by numbered responses to comments. EPA wishes to thank all those who reviewed the Draft EIS and provided written comments. Comments were received from the following agencies and individuals.

1. U. S. Forest Service, Rogue River National Forest
2. U. S. Department of Interior
3. U. S. Department of Commerce, National Marine Fisheries Service
4. U. S. Department of Agriculture Soil Conservation Service
5. U. S. Department of Housing and Urban Development
6. Advisory Council on Historic Preservation
7. Oregon Department of Soil and Water
8. Oregon Department of Fish and Wildlife
9. Oregon State Historic Preservation Officer
10. Mr. Al Alsing, City of Ashland
11. Mr. H. Tom Davis, Montgomery Engineers
12. Mr. Paul Dokey

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

ROGUE RIVER NATIONAL FOREST
P.O. BOX 520, MEDFORD, OR 97501

REPLY TO: 2540 Water Uses and Development September 7, 1979

SUBJECT: Reeder Reservoir Maintenance Operations DEIS

TO: Mr. Roger K. Mochnick M/S 443
Environmental Evaluation Branch
Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Following are our comments on the draft environmental statement on maintenance operations at Reeder Reservoir.

1 Page 55 - You are correct in stating that the general functional inspection conducted in 1970 led to a moratorium on logging activities in the Ashland Watershed. However, there was no interim plan prepared in 1973. The Forest Service has prepared several drafts of management plans for the watershed since 1970, but none have gone beyond the draft stage, so we are still managing under the moratorium instituted in 1970. The Forest Service in cooperation with the City of Ashland is currently writing an interim management plan for the watershed. We expect to have this plan completed soon. This effort is more properly in response to the local 208 Program than in response to the 1973 DEQ report.

2 Page 61 - We do not see the logic in assuming average annual sediment inflows of 18,000 to 24,000 cubic yards when, as you have stated, sediment typically enters in large amounts during major storms which are then followed by periods of relatively little accumulation. Therefore, we do not see the value in estimating either the costs or effects associated with the "average" when it is the massive amounts of sediment associated with major events that cause the problems.

3 Page 128 - We do not agree that Forest Service activities have compromised the watershed or been unwise. The watershed does not exist solely to provide water to the City of Ashland. It has a larger role in that it is part of the National Forest system and as such is to be managed for a variety of uses.

It is our opinion that, while individual activities may not have been up to the standards we desire, management of the watershed is desirable and the only way to assure continued production of high quality water.

3 A wildland watershed is not stated. The condition of the Ashland Watershed--by this we mean the biological as well as the physical--is deteriorating. We are concerned that no management will allow this deterioration to continue to such a point that a major fire or insect infestation may destroy those properties we all want to protect. You should realize that sound protection and management of the watershed by the Forest Service is essential. Therefore, we believe it is short-sighted on your part to advocate a "no management" position.

We were pleased to have the opportunity to comment on your DEIS and suggest you consider our response in the final statement.

DONALD H. SMITH
Forest Supervisor

Responses to Comments from U. S. Forest Service - Rogue River National Forest

1 The U. S. Forest Service (USFS) correctly points out that no interim management plan was ever adopted following the 1970 moratorium. The "interim plan" described in the Draft EIS on page 60 was in fact a draft of one proposed interim plan that was never approved. The EIS text has been changed to clarify this point.

2 The USFS questions the logic of estimating the average annual sediment inflows to Reeder Reservoir. Their comments correctly point out that sediment typically enters in large amounts at infrequent intervals, with small amounts at other times.

As stated in the EIS, the application of "average" figures can indeed be misleading. However, it is necessary to define relative cost levels for the various alternatives, and an average sediment volume provides the only practical basis for such evaluations. Further, the use of such an average figure allows an estimate of long-term total sediment contributions that might be expected, subject to the limitations explained in the EIS. It should also be pointed out that the cost figures provided by the City of Ashland are derived from actual experience following major events, and the unit costs used in the EIS are therefore believed to be representative.

3 The USFS also implies in their comments that EPA is advocating a "no management" position. The history of the presidential and congressional actions provides some insight on these concerns about management of the watershed. Presidents Theodore Roosevelt and Grover Cleveland set the watershed aside and reserved it "from entry or settlement", except as to entry initiated prior to the proclamation. The watershed lands were Oregon and California Land Grant lands which reverted to the United States ownership in 1916.

In a report to Congress in May 1936, Acting Secretary, R. G. Tugwell, successfully recommended, prior to its enactment, that H. R. 8312 contain the following provision:

> "That when the Secretary of Agriculture finds that merchantable timber may be cut without detriment to the purity or depletion of the water supply from such of the above-described lands title to which has been revested in the United States under the Act of Congress approved June 9, 1916 (39 Stat. 218), said Secretary is hereby authorized to dispose of such merchantable timber...".

The "above described lands" include the Ashland watershed.

3 Acting Secretary Tugwell's report further notes that:

> "The proposed legislation would place within the Rogue River National Forest certain described lands aggregating in area approximately 41,600 acres. They are mountainous timber-producing lands and undoubtedly should be under forest management and protection. About 21,000 acres were formerly a part of the Oregon and California Railroad land grant, title to which revested in the United States under the act of June 9, 1916. Approximately 1,700 acres are vacant, unreserved Government lands, while the balance, 19,000 acres, is in private ownership.
>
> "From information furnished this department it appears that the city of Ashland, Oregon, has urged that these lands be given a national forest status in order that they may be managed so as to adequately protect the city's source of water supply...
>
> "If the Oregon and California Railroad land-grant lands were disposed of in their present status under the act of June 9, 1916, the only receipts which would be derived therefrom would be those which came from the sale of timber. The city of Ashland wishes the lands placed under national forest management in order to protect its source of water supply and, therefore, quite likely would object to timber sales within the area..."

There seems to be no intent expressed in the above actions to embrace "no management" or a quasi-wilderness state for the watershed, nor is EPA suggesting a "no management" approach. Rather, EPA suggests that management should be directed toward protecting the water supply, recognizing the fragility of the watershed and its importance to downstream water quality and fisheries. Management need not involve repeated manipulations. In the Ashland watershed, sound management seems to require refraining from actions in the watershed which would induce additional adverse impacts.

See also the section in Chapter 6 on Ashland watershed management.

United States Department of the Interior
OFFICE OF THE SECRETARY
PACIFIC NORTHWEST REGION
500 N.E. Multnomah Street, Suite 1692, Portland, Oregon 97232

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OCT 4 1979
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ER 79/823

Roger K. Mochnick M/S 443
Environmental Evaluation Branch
Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, WA 98101

Dear Mr. Mochnick:

We have reviewed the draft environmental impact statement for Reeder Reservoir Maintenance Operations, Jackson County, Oregon. The following comments are provided for your consideration when preparing the final document.

1 We failed to find certain basic information necessary to adequately
understand and evaluate the project. For example, the most detailed
map of the reservoir is highly generalized (fig. 2-3. p. 18) and
topography or cultural features around the reservoir are not shown on
2 any map. The reservoir is stated to be up to 100 feet deep (p. 107,
par. 2), but no indication of the distribution of depths or of the
average depth was found. Consequently, it is not clear what depths
would be encountered in the dredging alternative. The boundary of the
Rogue River National Forest should be shown inasmuch as the high volumes
of sediment have been attributed to activities in that area. The
3 recommended structural improvements to the reservoir (p. xi, par. 1)
should be illustrated on drawings, diagrams, or maps, as their location
and design is not entirely clear from the verbal descriptions in the text.

4 The environmental statement suffers greatly from being completely devoid of information on sediment size, despite the fact that the statement is almost entirely concerned with removal of sediment from the reservoir. A modest effort to obtain a few sediment samples and determine their grain-size distribution would greatly increase the value of the study, because the size is directly related to distance and speed of transport downstream, to the potential harm to salmonids, which is a primary environmental concern (p. 102, par. 2), and possibly to the suitability for use of the sediment as fill material or for other purposes. We found no discussion of the latter possibility, but only an unsubstantiated conclusion that "Removal of the sediments from the creek system would largely mitigate nearly all of the impacts, although this is not considered a viable alternative by EPA" (p. x, par. 1).

5 Information should be provided on ground-water conditions and on ground-water/surface-water interrelationship of the area adjacent to the reservoir. Also, the potential for impacts of Alternative 3 (p. 112-117) and Alternative 4 (p. 117-120) on water levels in wells tapping shallow ground-water in the vicinity of the reservoir should be considered.

6 We find the draft environmental statement does not adequately describe the affected outdoor recreation opportunities which are currently available, nor does it adequately address the impact of the proposed alternatives. The statement should be expanded to include a "Recreation" element under the existing heading of "Regional Environment."

The project alternatives, as presently formulated, appear to have little impact on archaeological, historical and unique scenic resources. If the project alternatives should be reformulated to include land disposal of the sediments, provisions should be made for identification and evaluation of historic and archaeological resources in all project areas under 36 C.F.R. Part 800.4 in consultation with the Oregon State Historic Preservation Officer.

6 On page 83, paragraph 4, the statement is made, "As additional areas become available for public use, this impact of reservoir cleaning on aesthetic and recreational uses will decrease." We would expect that as additional areas of the Bear Creek Greenway are acquired by public agencies, increased silt in the river would have a far greater impact on recreational uses.

We would like to point out that Alternative 2 will have the least detrimental effects on spawning and emerging salmonids.

Thank you for the opportunity to review and comment on this document.

Sincerely yours,

Charles S. Polityka

Charles S. Polityka
Regional Environmental Officer

Response to Comments from the U. S. Department of Interior

1 Additional map information on the reservoir has been provided, namely a copy of the USGS topographic map (Figure 2-3) and Figures 2-1 and 2-2 have been amended to show the Rogue River National Forest boundaries.

2 The reservoir is 100 feet deep at the dam, with the reservoir bottom comprised of the natural stream channel and banks. As shown on the topographic map the reservoir is located in a relatively steep canyon with slopes of about 40 to 60 percent.

3 The sketches of proposed reservoir modifications, excerpted from the Montgomery report, are now included at the end of Chapter 2.

4 DOI comments on the lack of sediment size information. This is indeed one limitation on the depth and breadth of analysis undertaken in the EIS. Sediment size distributions, reliable hydrologic records of prior flood flows into Reeder Reservoir, and reliable frequency-discharge relationships for the watershed would have enabled a much more detailed analysis of sediment discharges, movement in Bear Creek, and duration and severity of impact. Unfortunately none of these data are available.

The last major sediment inflow to Reeder Reservoir occurred in 1974. Reportedly, dredging in that year encountered "relatively fine" sediments nearest the dam, and encountered increasingly coarse material toward the inflow points of the east and west forks. Debris, such as stumps and logs, was also encountered. All of this material was removed by 1976, and is no longer available for the performance of testing. No significant sediment inflows have occurred since 1974, and it is felt that whatever sediments are now present in Reeder Reservoir are probably not representative of the more damaging situations.

In any event, the prior sediments have been of a size and volume to cause the damages cited in the report. Additional detail on particle sizes of sediments would be of very limited usefulness without adequate hydrologic information, which is also lacking.

The suitability of this sediment for roadfill material was evaluated by the Talent Irrigation District in 1974. They reported using some of the material in this way, and noted instability in wet periods. Additional information is lacking.

4 Removal of sediments from the Bear Creek system would largely eliminate the sediment-induced impacts but might have other impacts on land use, historic features or archeologic values. These alternatives are briefly described in Chapter 3 together with the reasons for their exclusion from detailed evaluation. Also see the response to comment letter from the Advisory Council on Historic Preservation concerning cultural resources.

5 Groundwater resources in the reservoir vicinity are reportedly limited. The dam is poured against bedrock, indicating that groundwater may be restricted to fissures and faulted areas. A substantial groundwater body exists in the alluvium in the Bear Creek basin, and many producing **wells exist. However, the wells are not located near the dam,** and no groundwater impacts are expected from any of the alternatives.

6 The recreation section of the EIS has been expanded. In addition, the statement on page 83, paragraph 4 of the draft (now page 79, paragraph 4) has been corrected to properly reflect an increase in impact as recreational use of Bear Creek increases.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Environmental & Technical Services Division
P. O. Box 4332, Portland, Oregon 97208

September 11, 1979

FNW5:JRC

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Mr. Roger K. Mochnick M/S 443
Environmental Evaluation Branch
Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mr. Mochnick:

The National Marine Fisheries Service has reviewed the draft environmental impact statement for Reeder Reservoir Maintenance Operations, An Element of the Rogue Valley Water Quality Management Plan.

In order to provide as timely a response to your request for comments as possible, we are submitting the enclosed comments to you directly, in parallel with their transmittal to the Department of Commerce for incorporation in the Departmental response. These comments represent the views of the National Marine Fisheries Service. The formal, consolidated views of the Department should reach you shortly.

Sincerely yours,

Dale R. Evans

Dale R. Evans
Division Chief

Enclosure

General Comments

The DEIS adequately addresses concerns for resources for which we bear a responsibility and alternatives to reduce adverse impacts on these resources. Only two specific comments are offered below.

Specific Comments

REGIONAL ENVIRONMENT

A. Anadromous Fisheries of Bear Creek

1. Life History Characteristics and Resource Needs

1 Page 34, paragraph 3. The sources of information for critical periods for key life history stages of anadromous salmonids and physical resource needs, as listed in Appendix D, "...are based on information provided by the ODFW and additional literature on the biology of anadromous fishes." We recommend a minimum of at least one classic reference, for example, SHAPOVALOV AND TAFT (1954), be included for the interested reader.

2. Field and Laboratory Analysis of Stream Gravels

2 Page 45, paragraph 4. It is stated that "As expected, there was no indication of a fine sediment contribution from Ashland Creek at the time of sampling. The basis for this conclusion is not clear since samples were not taken in the creek or from Bear Creek just below its confluence with Ashland Creek. Reference to the possibility of Neil Creek being a significant contributor of sediments would be more substantiated if sampling in and/or just below Ashland Creek had yielded insignificant amounts of fine sediment. Understandably, if the last sluicing of the reservoir took place in 1976, subsequent sediments would be stored and not expected to be found in downstream sampling sites.

3 Page 46, Table 2-5. We recommend a map showing sampling points be provided or at least indicate these points on the Basin Map (p. 17). If the latter course is taken, Jackson Creek should be shown.

Response to Comments by National Marine Fisheries Service

1 Addition of a classic reference on the anadromous fishes is suggested. The Shapovalov and Taft work (1954) is now referenced in the text and bibliography.

2 NMFS comments that no gravel sample was taken in Ashland Creek, and that this leaves some conclusions unclear as to their basis. The sampling of gravels did not include Ashland Creek since the stream has been partly channelized and fringed by urban development, with few if any suitable spawning gravels existing. The conclusion that the samples did not indicate a fine sediment contribution from Ashland Creek was based on a comparison of samples 3 and 4, taken above and below the confluence of Bear and Ashland Creeks, as well as on the knowledge that Reeder Reservoir has not been cleaned since 1976.

The primary conclusions that are drawn regarding the existing condition of gravels in Bear Creek would likely not be changed by additional sampling, although additional data would provide a more complete picture. Further monitoring of the suitability of gravels of Bear Creek should be encouraged.

3 A map has been added to show the location of gravel sampling sites.

United States Department of Agriculture
Soil Conservation Service

1220 S. W. Third Avenue
16th Floor
Portland, OR 97204

September 13, 1979

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Mr. Roger K. Mochnick M/S 443
Environmental Evaluation Branch
Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mr. Mochnick:

The Soil Conservation Service has reviewed the Draft Environmental Impact Statement, Reeder Reservoir Maintenance Operations, An Element of the Rogue Valley Water Quality Management Plan. We offer the following comment.

1 An increase in sediment at the Reeder Reservoir is closely correlated with changes in land use and vegetation cover in the watershed.

We think a correction or improvement of the land-use vegetative cover conditions should be a prerequisite to any of the four alternatives discussed.

We appreciate the opportunity to review and comment on this draft.

Yours truly,

Guy W. Nutt
State Conservationist

cc: Director, Office of Federal Activities (Mail Code A-104)
Environmental Protection Agency
Room 537, West Tower
401 M. Street, S.W.
Washington, D.C. 20460

Administrator, SCS, USDA, Washington, D.C. 20013

Responses to Comments from Soil Conservation Service

1 Refer to the section in Chapter 6 on Ashland watershed and to the response to comment letter from the U. S. Forest Service.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
ARCADE PLAZA BUILDING, 1321 SECOND AVENUE
SEATTLE, WASHINGTON 98101

August 15, 1979

REGION X
Office of Community Planning
and Development

IN REPLY REFER TO:
10C

Roger K. Mochnick
Environmental Evaluation Branch
Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mr. Mochnick:

Re: Draft Environmental Impact Statement
Reeder Reservoir Maintenance Operations
Portland, Oregon

We have reviewed the impact statement submitted with your July 13, 1979 letter.

It appears that the Federal action will be your approval of a method for reservoir cleaning to be incorporated into the 208 Water Quality Management Plan.

1 We support the recommendation of the Rogue Valley Council of Governments for the City to continue the spring sluicing of Reeder Reservoir. We believe this will result in the least adverse impacts and will also be consistent with the Department of Environmental Quality's Waste Discharge permit.

Thank you for the opportunity to comment.

Sincerely,

Robert C. Scalia
Director
Regional Office of CPD

cc: Gerald Huard/HUD-Portland
Cliff Safranski/HUD-Portland

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AREA OFFICES
Portland, Oregon • Seattle, Washington • Anchorage, Alaska • Boise, Idaho
Insuring Office
Spokane, Washington

Responses to Comments from Department of Housing and Urban Development

1 Comments acknowledged.

Advisory Council On Historic Preservation

1522 K Street NW.
Washington D.C.
20005

Reply to: P. O. Box 25085
Denver, Colorado 80225

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August 6, 1979

Mr. Roger K. Mochnick
Environmental Evaluation Branch
Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mr. Mochnick:

This is to acknowledge receipt of the draft environmental statement for the City of Ashland Reeder Reservoir maintenance operations, Jackson County, Oregon, on July 27, 1979. We regret that we will be unable to review and comment on this document in a timely manner pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969.

Nevertheless, the Environmental Protection Agency is reminded that, if the proposed undertaking will affect properties included in or eligible for inclusion in the National Register of Historic Places, it is required by Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) to afford the Council an opportunity to comment on the undertaking prior to the approval of the expenditure of any Federal funds or prior to the issuance of any license. The Council's regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800.4) detail the steps an agency is to follow in requesting Council comment.

Generally, the Council considers environmental evaluations to be adequate when they contain evidence of compliance with Section 106 of the National Historic Preservation Act, as amended. The environmental documentation must demonstrate that either of the following conditions exists:

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Page 2
Mr. Roger K. Mochnick
Reeder Reservoir Maintenance Operations
August 6, 1979

1 1. No properties included in or that may be eligible for inclusion in the National Register are located within the area of environmental impact, and the undertaking will not affect any such property. In making this determination, the Council requires:

--evidence that the agency has consulted the latest edition of the National Register (Federal Register, February 6, 1979, and its monthly supplements);

--evidence of an effort to ensure the identification of properties eligible for inclusion in the National Register, including evidence of contact with the State Historic Preservation Officer, whose comments should be included in the final environmental statement.

2. Properties included in or that may be eligible for inclusion in the National Register are located within the area of environmental impact, and the undertaking will or will not affect any such property. In cases where there will be an effect, the final environmental statement should contain evidence of compliance with Section 106 of the National Historic Preservation Act through the Council's regulations, "Protection of Historic and Cultural Properties".

Should you have any questions, please call Jane King at (303) 234-4946,-an FTS number.

Sincerely,

Louis S. Wall
Chief, Western Division
of Project Review

Response to Comments from Council on Historic Preservation

1 The National Register has been consulted and a number of properties in Ashland and in other communities in the Bear Creek watershed are listed. None of the properties listed is within the stream channels or irrigation canals, which comprise the area of impact relative to this project. The State Historic Preservation officer has also been consulted. (See Oregon State Historic Preservation Officer comment letter below.) It is concluded that no properties (either presently listed or potentially eligible) exist within the area of impact, and that no impact on such properties could result from the proposed action.

OREGON PROJECT NOTIFICATION AND REVIEW SYSTEM

STATE CLEARINGHOUSE

Intergovernmental Relations Division
306 State Library Building, Salem, Oregon, 97310
Phone Number: 378-3732

PNRS STATE REVIEW

Project #: [illegible]07 4 1290 Return date: [illegible] 2 [illegible]

ENVIRONMENTAL IMPACT REVIEW PROCEDURES

If you cannot respond by the above return date, please call to arrange an extension at least one week prior to the review date.

ENVIRONMENTAL IMPACT REVIEW
DRAFT STATEMENT

☐ This project has no significant environmental impact.

☐ The environmental impact is adequately described.

☑ We suggest that the following points be considered in the preparation of a Final Environmental Impact Statement.

☐ No comment.

Remarks

The comments on the Draft Statement have not been adequately dealt with.
We recommend that the City of Ashland be encouraged to sluice Reeder Reservoir during a two week period of high water flow occurring between mid February and mid March.
We feel the lowest environmental impacts will occur with this method.

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AUG 30 1979
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Agency Soil & Water By

Responses to Comments from Oregon Department of Soil and Water

1 The soil and water agency comment regarding inadequate responses to prior comments were discussed with the agency. They indicated that this related to earlier comments on the Montgomery report not the EIS. The agency was unable to locate those comments, and no further response is attempted herein.

OREGON PROJECT NOTIFICATION AND REVIEW SYSTEM

STATE CLEARINGHOUSE

Intergovernmental Relations Division
306 State Library Building, Salem, Oregon, 97310
Phone Number: 378-3732

PNRS STATE REVIEW

Project #: ________ Return Date: ________

ENVIRONMENTAL IMPACT REVIEW PROCEDURES

If you cannot respond by the above return date, please call to arrange an extension at least one week prior to the review date.

ENVIRONMENTAL IMPACT REVIEW
DRAFT STATEMENT

( ) This project has no significant environmental impact.

( ) The environmental impact is adequately described.

(X) We suggest that the following points be considered in the preparation of a Final Environmental Impact Statement.

( ) No comment.

Remarks

Please see comments attached.

Reproduced from best available copy.

Oregon Department of Fish and Wildlife
comments on
Reeder Reservoir Maintenance Operations
Environmental Impact Statement

1 The Oregon Department of Fish and Wildlife recommends adoption of Alternative 4 for maintenance operations at Reeder Reservoir. We base our recommendation on the following points:

1. The outlet structure of Reeder Reservoir would be altered to more effectively pass winter flows and small debris.
2. The construction of Windburn Dam and Reservoir would provide storage for the City's needs while Reeder Reservoir was drawn down. On alternate years, Windburn Dam could be flushed into Reeder Reservoir, then refilled to supplement the storage from the increased sediment load.
3. Although sediment would be released downstream, it would be timed so natural flows would keep it moving through the system, consequently the impact on spawning steelhead would be lessened.

If Alternative 4 is adopted the EPA should adopt a time frame for site study, engineering, and construction. Without a specific committment the present siltation problem could continue for many more years.

2 The gravel sampling techniques employed by Jones and Stokes may not have provided a true comparison of particle sized within the gravel. We would suggest that additional sampling utilizing the freeze core substrate sampling method developed by Lopsteich EPA, Corvallis may be more meaningful.

We appreciate the opportunity to review and comment on this statement.

VICTOR ATIYEH
GOVERNOR

Department of Fish and Wildlife
OFFICE OF THE DIRECTOR
506 S.W. MILL STREET, P.O. BOX 3503, PORTLAND, OREGON 97208

August 30, 1979

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SEP 4 1979

Mr. Craig Partridge
U. S. Environmental Protection Agency
1200 - 5th Avenue
Seattle, Washington 98101

Dear Mr. Partridge:

The Oregon Department of Fish and Wildlife wishes to add a short supplement to our comments on the Reeder Reservoir Maintenance and Operation Environmental Impact Statement.

3 The sedimentation problems of the Ashland Creek watershed did not become apparent until in the 1960's. This closely coincides with the initiation of the multiple use management of the watershed in 1956 and the associated timber harvest and road construction. This may point out the importance of stringent watershed management policies, including rehabilitation of problem areas.

4 It was learned at a public hearing in Ashland on August 23, 1979 that water may be available from Hyatt Reservoir to supplement the Reeder Reservoir supply. This possibility may preclude further consideration of the Windburn Dam project, while still permitting flushing of sediment from Reeder Reservoir during periods of high stream flow. The construction of Windburn Dam could create additional disturbance to the watershed, further aggrevating the existing problem.

We have appreciated the opportunity to review the draft and trust that our comments have been helpful.

Sincerely,

Jim Newton

Jim Newton
Staff Biologist
Environmental Management
Section

JN:ek

Responses to Comments from Oregon Department of Fish and Wildlife

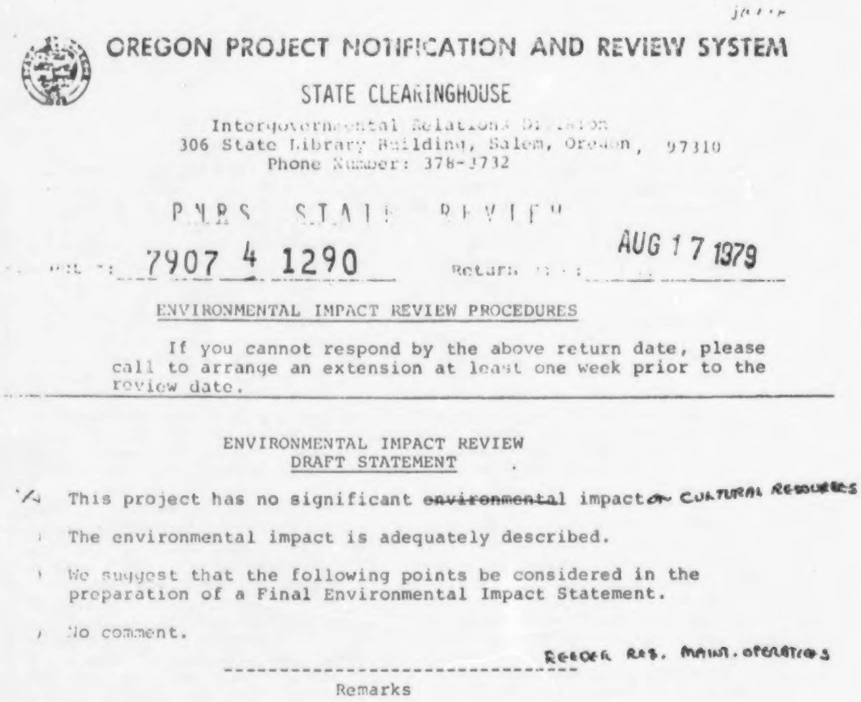
1 The Oregon Department of Fish and Wildlife (ODFW) recommends selection of Alternative 4 for three reasons. It should be noted that the first listed reason (that the Reeder Reservoir outlet would be modified) is recommended in conjunction with all four alternatives, and is not otherwise a factor that should be considered as differentiating among alternatives. Also see evaluation of alternatives in Chapter 5.

2 The ODFW also suggests the use of the freeze core method of obtaining gravel samples. Certainly greater accuracy in obtaining samples as well as a larger number of sampling locations would improve knowledge of the streams' suitability for fish habitat. However, the unavailability of a meaningful series of gravel samples in Bear Creek before, during and at intervals after the cleaning of Reeder Reservoir is a greater limitation in quantifying fishery impacts than is the sample methodology. The conclusions and recommendations of the EIS would not be altered by more accurate (and more costly) data on the current gravel conditions. The effects of cleaning are the major issue before EPA and the samples were not relied on to define those effects, nor are they a factor in EPA's recommendations.

It may be desirable for the ODFW to sponsor or participate in continuing monitoring of gravels in the Bear Creek system to assess spawning suitability and to establish a more reliable baseline for measuring future changes.

3 See response to the USFS comment letter and the section on Ashland watershed in Chapter 6.

4 The ODFW comments that a supplemental water supply could become available from outside of the Ashland watershed, allowing Alternative 4 to be implemented without the impacts that would be associated with the construction of Winburn Dam. If such a supplemental supply is obtained, and provides a sufficient supply with adequate reliability, then this supply could certainly provide the same function as Winburn Dam in the operation of Alternative 4. It could also improve the flexibility of the other three alternatives. (Note - the general impacts of construction of Winburn Dam are discussed further in a response to comments at the public hearing.) Also see EPA recommendation number 1 in Chapter 5.



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ENVIRONMENTAL IMPACT REVIEW PROCEDURES

If you cannot respond by the above return date, please call to arrange an extension at least one week prior to the review date.

ENVIRONMENTAL IMPACT REVIEW
DRAFT STATEMENT

✓ This project has no significant ~~environmental~~ impact on CULTURAL RESOURCES

☐ The environmental impact is adequately described.

☐ We suggest that the following points be considered in the preparation of a Final Environmental Impact Statement.

☐ No comment.

REEDER RES. MAINT. OPERATIONS

Remarks

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Response to Comments from Oregon State Historic Preservation Officer

Comments acknowledged.

Statement of Allen A. Alsing, Director of Public Works, City of Ashland at the August 23, 1979, public hearing concerning the draft EIS on Reeder Reservoir maintenance operations.

My name is Al Alsing and I'm the Public Works Director for the City of Ashland. This statement presents the City's position concerning the operation and maintenance of Reeder Reservoir, the management of the Ashland Watershed and the general future of Bear Creek. I appreciate the opportunity to present our views at this hearing. As part of the City's testimony, Mr. H. Tom Davis, Supervising Engineer for Montgomery Engineers, will present a statement which we ask to be included in the hearing record.

1 It is the City of Ashland's position that any EPA recommendation at this time promoting dredging over sluicing of Reeder Reservoir would be premature. We feel strongly that continuation of the City's present approach to cleaning the Reservoir utilizing draw-down and sluicing in the early spring during high snow-pack years is the most reasonable alternative given our present knowledge. It is our opinion that our current program should be continued until more is known about the future erosion of the Ashland watershed; the hydrology and sediment movement characteristics of Ashland Creek and Bear Creek; the relationships between potential sediment reductions and fisheries associated with the various alternatives; and the relative impacts of other sources of Bear Creek water quality and fishery problems such as agriculture, construction, and industrial runoff. We believe the draft EIS supports this position.

2 We believe that the emphasis should be on maintaining and restoring the Ashland watershed and on examining Bear Creek in a comprehensive manner followed by non-point source controls applied equitably to each source. If EPA wants to do the maximum they can to reduce the Reeder Reservoir impact on Bear Creek fisheries, we suggest that they join the City of Ashland and Rogue Valley Council of Governments in encouraging the Forest Service to solve the existing watershed problems and to not create new ones.

1 I would now like to expand briefly on the question of dredging versus sluicing in the spring as alternatives for maintaining the Ashland water supply facilities. As stated in the "Summary" of the draft EIS, very little is known about the fisheries benefit associated with the dredging versus spring sluicing alternatives. In the summary it is stated that "dredging has the greatest potential for reducing the severity of water quality violations" and goes on to point out that "since quantification of sediment movement is beyond the scope of this DEIS, the degree to which these differences would benefit or adversely affect the fisheries is unknown". As states on page 25 of the DEIS, Ashland Creek does not stand alone as a contributor of sediment to the Bear Creek System. Neil Creek also contains granitic soils. On page 45 of the DEIS, referring to data collected during the study, it is stated that "Neil Creek, which drains part of the eastern slope of the Ashland stock batholith, may contribute significant amounts of fine granitic sediment to Bear Creek." Furthermore, the hydrology of the Bear Creek/Ashland Creek systems is inadequately understood at the present time to assess the movement and impact of sediments. As the DEIS states "thus the hydrologic information

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1 necessary to estimate a relationship between stream flow and sediment volumes is lacking" (p. 54).

We would also like to point out that the DEIS states under the dredging alternative that the dredging would be carried out at times of high stream flow. It should be noted that high water is not defined in the DEIS and during most years the highest flows are in the spring of the year when normal sluicing operations take place. It seems unreasonable to expend extra monies for purchase, operation, and maintenance of a dredge to be used, for the most part, at a time of year when sluicing is normally done.

In view of the above, it would seem very inappropriate to us for EPA to recommend the high cost dredging alternative, particularly when our experience has indicated major problems with dredging. At some point, when the contribution from other sources is understood relative to the contribution from Ashland Creek it may be that a dredge would be worth the effort. However, at the present time we do not believe that this is the case. We feel that the draft EIS substantiates this.

We do not mean to give the impression that we gloss over the importance of reducing Ashland Creek sediment contribution to the Bear Creek system, for just the opposite is true. We simply don't want to be forced into being the first to take action when that action involves high cost methods of doubtful benefit. In that light we suggest that the EPA, Oregon Department of Environmental Quality, the Rogue Valley Council of Governments and its local participants continue to develop an understanding of all Bear Creek nonpoint sources of water pollution. At the same time we urge that progress be made on developing comprehensive programs of non-point source control and we understand that this has been started.

3 One thing which cannot be overemphasized is the need for continued stream flow and sediment movement monitoring in Ashland Creek and Neil Creek. In addition, more Ashland watershed research is needed concerning the role of channel erosion, which we believe to be minimal in the Ashland watershed. One of the most important needs is for Ashland field data concerning surface erosion rates in the various portions of the road prism, the logged areas and the Ashland ski area.

It seems clear that road construction/maintenance and logging in the Ashland watershed are the sources of the Reeder Reservoir sediment releases. We are unaware of any EPA pressure being exerted on the Forest Service to remedy past mistakes and avoid future ones. To the contrary it seems that the City of Ashland and the Rogue Valley Council of Governments have been left somewhat alone to challenge a major federal agency to do what is needed in the watershed. To date our working relationship with the Forest Service has been good but our success in getting needed management decisions has been very limited. The Forest Service seems to be changing direction in their current planning on the minor points but changing very little on the major points. For example, it was pointed out in a March 27, 1979, memorandum from James B. Wolf, Range, Wildlife and Watershed staff member to the Forest Supervisor, Rogue Valley National Forest that there are certain areas of agreement and nonagreement between the Forest Service and the City. Areas of agreement can be summarized as follows:

1. No grazing within the watershed.
2. No expansion of the Ashland ski area without a DEIS.
3. Recreation activities such as skiing, fishing, hunting and hiking would continue under present constraints with no ORV use or overnight camping.
4. Fire protection practices would continue.
5. Minimal road maintenance of certain roads.
6. Certain types of restoration for the road system.
7. Fuel break construction of selected breaks.

It is pointed out that these are somewhat minor concessions. On the other hand the areas of nonagreement, which are summarized as follows, represent the major factors contributing to the degradation of the Ashland watershed, the interference with the City of Ashland's water supply system and eventual impairment of downstream fisheries habitat, irrigation facilities and recreation potential.

1. The City's position is that logging should be eliminated from the watershed and the Forest Service "has not agreed to this approach to managing the watershed".
2. The City does not agree with salvage and sanitation logging and the Forest Service continues to discuss this as an alternative.
3. It is the City's position that no more roads should be built within the watershed and most of the current roads should be "put to bed" except for minimal custodial and fire protection uses. We feel that the available information and analyses support this position. The Forest Service states that "this option should be kept open".
4. The City has strongly recommended that the watershed be withdrawn from mineral entry in view of the enormous impact that even minimal exploration activities could have on our facilities and the downstream waters. The Forest Service acknowledges that little, if any, mineral potential exists in the watershed but states that "the Forest Service while recognizing that a withdrawal of Ashland watershed per se to preserve a watershed's water quality would have tremendous effects on the mining industry nationwide".
5. There is some disagreement between the Forest Service and the City concerning the type of fire management necessary for the watershed. We feel that our approach of minimizing human activities within the watershed and maximizing fire observation and quick control is not only the most logical but backed up by the history of fires within the Rogue River area.

In summary, it is the City of Ashland's opinion that we are presently operating on a program which represents the most cost effective and environmentally sound solution to the City's water supply problems and the problems with downstream fisheries, water quality, irrigation systems and recreation. We do not disagree with the contention that much needs to be done in the Bear Creek basin to restore and enhance the water resource values which have been lost. However, we feel that before a capital and energy intensive program is recommended, definite progress should be made in 1) knowing that a comprehensive control program can result in the desired benefits and 2) that the other needed control elements, particularly involving nonpoint sources, will also be implemented. We don't mind doing our part, but we don't want to spend money foolishly or embark on costly programs of questionable merit.

Again, let me thank you for the opportunity to present the City's position concerning the operation of Reeder Reservoir.

Response to Comments from Mr. Al Alsing

1 Regarding the City of Ashland's preference for the spring sluicing alternative, see Chapter 5, IDENTIFICATION OF EPA PREFERRED ALTERNATIVE.

2 Regarding Ashland watershed management, see section on that issue in Chapter 6. Also see response to comment letter from the Forest Service.

3 EPA approval of the Ashland watershed element of the Rogue Valley 208 Plan contained a condition that an expanded monitoring program be part of the long-range plan for the watershed to be prepared by the U. S. Forest Service. The recently completed interim plan indicates that certain limited erosion and water quality monitoring activities are currently taking place and will continue.
4 It is not clear from the interim plan whether and what expanded monitoring activities might be incorporated into the long-range plan.

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC., 7000 S.W. Hampton Street, Suite 215, Portland, Oregon 97223 (503)620-9053

Statement of H. Tom Davis, Supervising Engineer, Montgomery Engineers, for the City of Ashland concerning the Draft Environmental Impact Statement on Reeder Reservoir Operation and Maintenance.

I'd like to briefly describe certain aspects of our 1977 report and subsequent work with the City of Ashland as related to the draft EIS and the relationships between Bear Creek, the Ashland watershed and Reeder Reservoir. I believe the draft EIS adequately dealt with the full range of alternatives for removing sediment from Reeder Reservoir. My presentation will cover six general topics including 1) existing problems and the future of Bear Creek, 2) streamflow and sediment relationships in the Ashland/Bear Creek systems, 3) logging in the Ashland watershed, 4) road maintenance in the Ashland watershed, 5) surface erosion and 6) fire management.

EXISTING PROBLEMS AND THE FUTURE OF BEAR CREEK

I believe the draft EIS did a good job of pointing out that there are numerous sources of Bear Creek sediment, turbidity, bacteria and nutrients. The discussions and analyses concerning the fishery and stream gravels on pages 39 through 47 is well worth reading as background for planning future wastewater management programs in the basin. As was mentioned in this portion of the draft EIS, timber harvesting, roads, reservoir operations, agricultural practices, gravel mining,urbanization, domestic and industrial wastewater, and numerous other developments have resulted in detrimental changes in Bear Creek's temperature, hydrologic and nutrient regimes; and increased the input of sediment, bacteria, warm water predaceous fish and turbidity caused by fine colloidal suspensions. In addition, as the draft EIS points out, much of the stream habitat has been directly destroyed, various migration barriers are in the stream, flows are often inadequate and vegetation encroachment on the channel has become more pronounced primarily because of the managed flow regime. In addition, as is pointed out on page 31, the water quality standards for coliform bacteria and nutrients are insufficient to protect the beneficial uses of the stream from point sources.

To complicate the Bear Creek situation, many of the most important sources of pollution are nonpoint in nature. Thus any solution will have to deal with complex physical interrelationships and probably involve high levels of public education, extensive best management practices and non traditional wastewater management techniques. All of these can be accomplished but often require more time to develop, come to agreement on and implement.

The reason for bringing this out is to emphasize what Al Alsing has stated previously, that a capital intensive program for Reeder Reservoir, which may not even bring about significant benefits, would be inadvisable at this time until additional progress is made on some of the other pollution control and research programs needed in Bear Creek basin. In spite of the complexity of problems, Bear Creek can be restored and enhanced for both fisheries and recreation, provided that the steps taken are justified and the early programs demonstrate more success than failure.

STREAMFLOW AND SEDIMENT RELATIONSHIPS IN THE ASHLAND/BEAR CREEK SYSTEMS

As it is pointed out on pages 47 through 54 of the draft EIS, the 1974 flood hydrology is not well understood. As evidence to this, recent estimates concerning recurrence intervals for that event have ranged from 30 years to 800 years. It is very likely that the two extremes in this range are both incorrect. Certainly the 800 year recurrence interval is not in line with the City's observations concerning Ashland Creek flooding and the DEIS recognizes this on page 51. The authors acknowledge that an understanding of the Ashland Creek hydrology, particularly involving flood frequencies, is necessary to understand sediment volumes, movement and deposition. However the limitations to realize this for Ashalnd Creek is recognized and it is concluded that "the hydrologic information necessary to estimate a relationship between stream flow and sediment volumes is lacking". To compound the difficulty, the relationships between downstream sedimentation originating in the Ashland watershed, and the Bear Creek fisheries is also presently unknown.

In view of these unknowns, which are well pointed out in the draft EIS, it would not seem prudent for the City of Ashland to commit to a dredging program which they are reluctant to undertake because of economic and O & M considerations. Although our 1977 report recommended dredging, the major reasons were to conserve water storage in the Ashland municipal water system and give fishery protection the benefit of any doubt. Given Ashland's understandable reservations about a dredging program, and the high degree of uncertainity concerning fishery benefits which was brought out in the EIS it seems inadvisable to us for Ashland to implement such a program. At least not until the storage needs and fishery benefits become far more evident than they are today.

LOGGING AND ROAD CONSTRUCTION IN THE ASHLAND WATERSHED

We concluded in 1977 that over three-fourths of the sediment in Reeder Reservoir, which eventually had to be released into Ashland Creek, resulted from road construction and maintenance, logging and the Mt. Ashland ski area. During the last 2 to 3 years we have exchanged information and observations with both the forest administration and research divisions of the Forest Service concerning the Ashland watershed. They have examined and critiqued our evaluation and we have examined and critiqued their's.

Based on our original watershed study and on the subsequent years of exchanging ideas and information on the subject of erosion, it is still our conclusion that by far, the largest percentage of sediments which eventually were deposited in Reeder Reservoir and subsequently released to Ashland Creek and Bear Creek, resulted from man-caused disturbances. Specifically these included road construction, operation and maintenance; logging and ski area development. If this is the case, and we believe it to be, Reeder Reservoir is no more than a "middle man" in the process of watershed erosion and Bear Creek sedimentation.

As pointed out on page 55 of the draft EIS, the Forest Service has expressed it concern about our erosion analysis methodology. This methodology is discussed in Attachment A. After expressing that concern the Forest Service consulted with their leading batholith erosion research specialist who examined the Ashland batholith during a two day tour. His conclusions are summarized as follows:

> "Thus, I would not hesitate to extrapolate the basic principles found in the Idaho batholith to the Ashland watershed. However, the physical properties of the two areas do vary somewhat, so I would be reluctant to extrapolate erosion and sedimentation rates directly from one area to the other without some on-site data for verification."

In effect this statement coincides very well with our description of the results and limitations of our 1977 analysis. The primary difference is that from a research standpoint, site specific research data to determine basic coefficients such as erosion rates is a standard recommendation. In our case we recognized that such data would be desirable, but, the option of increasing the funding level and extending the time period of the study, both of which would have been required to obtain such information, were not options open to us.

The Forest Service also expressed concern that the Montgomery analysis did not include channel erosion. It is our opinion that channel erosion, while undoubtedly occuring constantly in the Ashland watershed, is primarily an intermediate process involving the movement of sediment eroded in the watershed proper, particularly from areas of man-caused disturbance, to some downstream location such as Reeder Reservoir. There are methods whereby the channel erosion phenomonon can be better understood and these should be explored. However we suspect, based on field inspection, that the volume of material eroded from the channel after long term residence in the channel will be very low and that most of the channel material eroded will have been its last location for less than 5 years.

ROAD MAINTENANCE

Up until the last few years most of the concern about erosion of granitic soils was focused on the construction of roads. Various research projects have demonstrated conclusively that road construction, particularly during the first 2 to 4 years after construction, results in very high rates of erosion on the cut/fill and road surfaces, and in the ditch. In discussing this with the Forest Service erosion specialists we found that current research was examining road maintenance as a potentially major contributor to erosion and sedimentation.

The early batholith erosion studies examined jammer roads which were constructed and used for a few years and then no longer used or maintained. This was one of the primary reasons for this return of post construction erosion rates to near natural levels after a few years. It was found that this resulted from "armoring" of the road prism, or the removal of the fine grain material. Such an armored condition is the antithesis of a "good" road surface and road blading and maintenance operations are specifically intended to resurface and reshape by replacing the fine grained particles which have been lost. We discussed the likely results of road grading with various erosion specialists and concluded that the process, although understood qualitatively but not very well quantitatively, should be integrated into our erosion model. This was done by adjusting post construction erosion rates and was a major factor in our erosion budget which coincided reasonably well with the larger estimates of material deposited in Reeder Reservoir during the 22 year period examined.

It was our conclusion in 1977 and it is still our conclusion that one of the highest contributors of eroded sediment in the Ashland watershed is the annual maintenance or blading of the road system. Since maintenance is required if any major activities such as logging occur in the watershed we recommeded that as much of the road system as possible be put to bed and that access, particularly involving motorized vehicles, be held to an absolute minimum. In view of this and the other associated problems, logging does not appear to be an appropriate use if the municipal water supply values of the Ashland watershed are to be maintained.

SURFACE EROSION

Concerning surface erosion of the road prism, we believe that an additional process may be operating. We find that current research indicates that very high surface erosion rates are probably occurring on the cut surface of the road prism. In our erosion budgeting we assumed that the cut surface would return to near natural rates after a few years. If this is not the case, and if the rates which appear to be occurring are applied, our 1977 estimate of erosion over the 22 year period would be very close to the estimates of sediment volume removed over that period from Reeder Reservoir.

The implication of this would be that not only is the construction of roads and the maintenance of the road surface on batholith soils extremely problematical from an erosion standpoint, but also the existence of the fill surface. For watersheds and streams where sediment movement and downstream deposition must be minimized or avoided, this would mean that very little, if any, disturbance of the watershed could be tolerated.

FIRE MANAGEMENT

There seems to be some confusion about our conclusions and recommendations concerning fire management in the watershed, so I would like to briefly summarize those conclusions.

1. The history of fires and fire management in the Rogue Valley indicates that the major problem fires were man-caused and that natural fires were generally suppressed in a short time.

2. There is a large potential for increased erosion due to an intense fire in the watershed. However there is research information available

that demonstrates that wildfire through unlogged watersheds can result in significantly less erosion and sediment movement than wildfire through a logged watershed.

3. We concluded that high levels of human activity such as that associated with logging or extensive over-night camping could be expected to increase the likelihood of a large problem fire.

4. We recommended that fire management involving intensive observation and quick response in suppressing all fires was the most appropriate program for the Ashland watershed.

5. We also concluded that, although the removal of fuel from the watershed would present certain benefits the extensive logging activities required to do this effectively would present far more hazards and potential for loss than for benefit.

In summary, it is our conclusion that the Ashland watershed is extremely sensitive to any man-caused disturbance. We are confident that if the needed research on surface erosion rates, sediment transport and channel erosion is done and another erosion budget performed, that the general conclusions we made in 1977 would be found to be correct. The construction, maintenance and even existence of roads in a watershed such as the Ashland watershed is incompatible with keeping downstream sedimentation to a minimum. There may be ways of removing some timber from such a watershed without risking high increases in downstream sedimentation but even these should be viewed very cautiously. If downstream fisheries or municipal water facilities are involved such timber removal should be attempted only if it can be accomplished with few, or preferably no, roads.

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC., 7000 S.W. Hampton Street, Suite 215, Portland, Oregon 97223 (503)620-9053

ATTACHMENT A - MONTGOMERY EROSION ANALYSIS

For the purposes of our watershed evaluation, we developed a methodology which can generally be described as an erosion budgeting. We simple catagorized various aspects of watershed conditions in a way that allowed us to assign erosion rates for each category. To a large degree the catagorization depended upon the type of surface erosion rate data that was available. We were familiar with the very high erosion experienced in the extensive Idaho batholith. We were also aware that most of the erosion research on batholith soils had been done at the Intermountain Forest and Range Experiment Station of the U. S. Forest Service in Boise. Ironically, the soil scientist who classified most of the Idaho batholith also classified the Ashland batholith. Based on information and conclusions supplied by our soils consultant, Earth Sciences, Inc., and on discussions with erosion specialists of the Intermountain Research Station, we concluded that while certain differences in soil characteristics and meteorology existed, the two batholith formations could be expected to involve similar erosion processes. Thus we concluded that in spite of the minor differences, and in view of the lack of any Ashland batholith surface erosion data, the research information collected on the Idaho batholith concerning surface erosion would be generally applicable to the Ashland batholith.

In reviewing the Forest Service's analysis of Ashland watershed erosion, we found that they had concentrated their efforts on the phenomenon of mass erosion (or landslide-type events). They had estimated the volumes of material eroded based on the volume of eroded depressions observed in the field. We reviewed their work and concluded that for the mass erosion which had occurred in the watershed, the Forest Service had done an excellent job. However, we were concerned that surface erosion, which had played such a major role on other batholith formations, was not considered. We concluded that in our analysis we would estimate the overall contribution of the various man-caused and natural processes, including surface erosion, using a modeling or budgetting technique. However to do so we had to have surface erosion multipliers to complement the Forest Service's estimate of mass erosion. No such data was available for the Ashland watershed and the scope of our study was not such that this information could be collected, since it requires a considerable study period of from one to three years. In view of this and in view of the information available from the Intermountain Research Station and the need to make at least rough estimates of relative contribution, we "modeled" the Ashland watershed erosion for mass and surface erosion over a 22 year period.

We do not pretend that this analysis is perfect. Furthermore, we have emphasized that surface erosion rate information should be collected specifically for the Ashland watershed. We believe that our analysis procedure is sound and that our conclusions are correct, but recognize that any fine tuning would require site specific surface erosion rates. An evaluation of channel erosion may also be useful.

Responses to Comments from H. Tom Davis, Montgomery Engineers

Mr. Davis' comments deal primarily with the Ashland watershed. Please see the section on that issue in Chapter 6. Also see the response to comment letter from the Forest Service.

Statement of Mr. Paul Dokey

As you may or may not know, the City of Ashland takes water from Howard Prairie and Hyatt Lakes Reservoirs on a contingency basis. The Town of Talent uses this water continuously for all purposes.

In light of the Cameron, Anderson Stream Monitoring Program conducted during FY 1977 **(herbicide-spray-program)** in the Coos Bay District BLM, "...with aerial application the chances of these herbicides ultimately entering the stream system is approximately 70 percent...", we feel the implementation of a spray program within any area that slopes downhill toward these lakes or watershed is inadvisable.

We understand that BLM is not a scientific research organization and cannot be expected to document research on pesticides. However, it has come to our attention that research does exist that seriously questions the safety of some of the herbicides slated for use. A 1975 GAO survey of the EPA revealed unsettling evidence that this organization cannot be relied upon to ensure the safety of the chemicals it registers.

Experiments by DOW in 1971 (Schwetz, Sparschy, & Gehring) The Effects of 2, 4, -D, and Esters of 2, 4, -D on Rat Emeryonal, Fetal, and Neonatal Growth and Development produced a wide range of congenital defects of the skeleton. Clearly this is terotogenic under the standard definition of the term.

Also "Studies by Dr. Diane Courney, Chief Toxicologist for EPA revealed that low doses of 2, 4, -D, for a long period of time (such as would likely occur from drinking contaminated water) cause more fetal damage than large doses". Quote from The Other Face of 2, 4, -D, parenthesis ours.

Nine cancer principles were formulated by an EPA independent experts team: Melvin Reuber, Umberto Saffiotti, Arthur Upton, Adrian Gross, and Samuel Epstein. Ref. to the Politics of Cancer, 1978 Sierra Club Books by Samuel Epstein. Four of these principles are of particular interest to us:

1) A carcinogen is any agent which increases tumor induction in man or animals.

6) There is a great variation in individual susceptibility to carcinogens.

7) The concept of a "threshold" exposure for a carcinogenic agent has no practical significance because there is no valid method for establishing such a level.

9) Any substance which produces tumors in animals must be considered a carcinogenic hazard to man if the results were achieved according to the established parameters of a valid carcinogenesis test.

The following quote appears in Vegetation Management with Herbicides, Western Oregon, Final Environmental Statement 1978 "...Any chemical -- no matter how 'poisonous' -- has some dosage level limits within which it is perfectly safe". This is taken from Oregon Weed Control Handbook, February 1977 Ext. Service, OSU., Corvallis.

This statement is a key assumption upon which the use of pesticides (which includes herbicides) is based and from which safety tolerance levels are justified. It is in direct contradiction to the EPA cancer guidelines cited above. (The no threshold level effect also applies for mutagenicity and teretogenicity according to Dr. Epstein.) The Weed Control Handbook continues to compare herbicides with table salt and explains that salt can also kill in high doses. There is no valid basis for comparison between these substances. The molecular activity of a carcinogen, mutagen, or terotagen is on a completely different level. There are hundreds of chemicals now in use that are NOT teretogenic, mutagenic or cancer causing. 2, 4, -D is simply not one of these benign chemicals.

As far as the use of Roundup is concerned, the Fish-Pesticide Research Laboratory, Fish and Wildlife Service, Columbia, Missouri published a report showing that glyphosate, the active ingredient, is not overly toxic or persistent but noted that the INERT ingredient is persistent and extremely toxic to fish. The EPA requires no data to be submitted from chemical firms on the behavior of their inert ingredients. What this "ingredient" is, is not even listed on the label.

As it is further known that herbicides bioaccumulate as they move up the food chain, the risk of animal and human contamination magnifies.

If the BLM, EPA, or any other agency can supply valid scientific data (which we retain the right to review in detail), we will be only too happy to retract our position. However, we do not believe that evidence exists sufficient to prove that these chemicals are harmless. In the absence of this evidence, agencies planning to employ chemical forest management would do well to look to alternative methods of conifer release and site preparation.

Responses to Comments from Paul Dokey

Mr. Dokey comments that a water quality impact related to erosion may occur from BLM's application of pesticides to the Howard Prairie and Hyatt Reservoir watersheds. These reservoirs currently supply a portion of Ashland's domestic water supply through the Talent Irrigation system. The water is blended with Ashland Creek water at the treatment plant to provide the city's supply. Mr. Dokey points out that BLM's proposed spray program would include application of 2,4-D, atrazine, Roundup, dalapon and Krenite within 800 feet of the reservoirs and that the chemicals may be dangerous to human health. Mr. Dokey also indicated that tests show measurable amounts of 2,4-D, 2,4,5-TP and Silvex in Medford's drinking water.

While beyond the defined scope of this EIS, the concerns are important. A check with the City of Ashland confirmed that Hyatt and Howard Prairie may in fact provide domestic drinking water in Ashland at certain times. A check with BLM revealed that the spraying took place, and that additional spraying is likely to occur in the future. BLM has discussed the spraying with the city and has provided data on application methods and locations. BLM believes the precautions taken in application to be adequate to protect against surface water contamination (Francis, pers. comm.).

The City of Ashland indicates that water from Howard Prairie Reservoir and potentially from Hyatt Reservoir is provided by Talent Irrigation District during the irrigation season only, and is blended with Ashland Creek water to supplement that source. The city council has requested staff to have this supply tested for herbicides each year prior to use (Alsing, pers. comm.).

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APPENDIX A

OREGON STATE WATER QUALITY STANDARDS FOR THE ROGUE RIVER BASIN

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WATER POLLUTION

DIVISION 41

State-Wide Water Quality Management Plan, Beneficial Uses, Policies, Standards, and Treatment Criteria for Oregon

[ED. NOTE: The Tables and Figures referred to within the text of this division may be found at the end of this division.]

Preface

340-41-001 The sections which follow, together with the applicable laws of the State of Oregon and the applicable regulations of the Environmental Quality Commission, set forth Oregon's plans for management of the quality of public waters within the State of Oregon.

Under this plan, the Department of Environmental Quality will continue to manage water quality by evaluating each discharge and activity, whether existing or a new proposal, on a case-by-case basis, based on best information currently available and within the limiting framework of minimum standards, treatment criteria, and policies which are set forth in the plan.

The EQC recognizes that the deadlines for adoption of this plan prevented thorough involvement by local government in the development and review of the plan. Accordingly the Department will review the contents of this plan with affected local governments and will use their comments and suggestions in preparing amendments for consideration by the EQC not later than December, 1977. At a minimum, the processes of coordination with local governments will consist of the following elements:

(1) Work with county coordinators to set up meetings to explain the plan to groups of local governments and solicit their comments.

(2) Provide copies of the plan and supporting documents to any affected local governments who have not already received them.

(3) Seek input from Councils of Governments.

(4) Upon request, visit local level governments to discuss the plan.

(5) Work with statewide associations of local governments and others to inform local governments of the plan.

Statutory Authority: ORS 468.020 and 468.735
Hist: Filed and Eff. 1-21-77 as DEQ 128

340-41-005 [Filed 6-1-67 as SA 26
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Definitions

340-41-006 Definitions applicable to all basins unless context requires otherwise:

(1) "BOD" means 5-day 20° C. Biochemical Oxygen Demand.

(2) "DEQ" or "Department" means the Oregon State Department of Environmental Quality.

(3) "DO" means Dissolved Oxygen.

(4) "EQC" means the Oregon State Environmental Quality Commission.

(5) "Estuarine waters" means all mixed fresh and oceanic waters in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties.

(6) "Industrial waste" means any liquid, gaseous, radioactive, or solid waste substance or a combination thereof resulting from any process of industry, manufacturing, trade or business, or from the development or recovery of any natural resources.

(7) "Marine waters" means all oceanic, offshore waters outside of estuaries or bays and within the territorial limits of the State of Oregon.

(8) "mg/l" means milligrams per liter.

(9) "Pollution" means such contamination or other alteration of the physical, chemical, or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt, or odor of the waters, or such radioactive or other substance into any waters of the state which either by itself or in connection with any other substance present, will or can reasonably be expected to create a public nuisance or render such waters harmful, detrimental, or injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life, or the habitat thereof.

(10) "Public water" means the same as "waters of the state".

(11) "Sewage" means the water-carried human or animal waste from residences, buildings, industrial establishments, or other places together with such groundwater infiltration and surface water as may be present. The admixture with sewage as herein defined of industrial wastes or wastes, as defined in subsections (6) and (13) of this section, shall also be considered "sewage" within the meaning of this division.

(12) "SS" means Suspended Solids.

(13) "Wastes" means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive, or other substances which will or may cause pollution or tend to cause pollution of any water of the state.

(14) "Waters of the state" include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

(15) "Low Flow Period" means the flows in a stream resulting from primarily groundwater discharge or baseflows augmented from lakes and storage projects during the driest period of the year. The dry weather period varies across the state according to climate and topography. Wherever the Low Flow Period is indicated in the Water Quality Management Plans, this period has been approximated by the

inclusive months. Where applicable in a waste discharge permit, the Low Flow Period may be further defined.

(16) "Secondary Treatment" as the following context may require for:

(a) "Sewage wastes" means the minimum level of treatment mandated by EPA regulations pursuant to Public Law 92-500.

(b) "Industrial and other waste sources" imply control equivalent to Best Practicable Treatment (BPT).

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Policies and Guidelines Generally Applicable to All Basins

340-41-026 (1) In order to maintain the quality of waters in the State of Oregon, it is the policy of the EQC to require that growth and development be accomodated by increased efficiency and effectiveness of waste treatment and control such that measurable future discharged waste loads from existing sources do not exceed presently allowed discharged loads unless otherwise specifically approved by the EQC.

(2) For any new waste sources, alternatives which utilize reuse or disposal with no discharge to public waters shall be given highest priority for use wherever practicable. New source discharges may be approved by the Department if no measurable adverse impact on water quality or beneficial uses will occur. Significant or large new sources must be approved by the Environmental Quality Commission.

(3) No discharges of wastes to lakes or reservoirs shall be allowed without specific approval of the EQC.

(4) Log handling in public waters shall conform to current EQC policies and guidelines.

(5) Sand and gravel removal operations shall be conducted pursuant to a permit from the Division of State Lands and separated from the active flowing stream by a watertight berm wherever physically practicable. Recirculation and reuse of process water shall be required wherever practicable. Discharges, when allowed, or seepage or leakage losses to public waters shall not cause a violation of water quality standards or adversely affect legitimate beneficial uses.

(6) Logging and forest management activities shall be conducted in accordance with the Oregon Forest Practices Act so as to minimize adverse effects on water quality.

(7) Road building and maintenance activities shall be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

(8) In order to improve controls over non-point sources of pollution, federal, state, and local resource management agencies will be encouraged and assisted to coordinate planning and implementation of programs to regulate or control runoff, erosion, turbidity, stream temperature, stream flow, and the withdrawal and use of irrigation water on a basin wide approach so as to protect the quality and beneficial uses of water and related resources. Such programs may include, but not be limited to, the following:

(a) Development of projects for storage and release of suitable quality waters to augment low stream flow.

(b) Urban runoff control to reduce erosion.

(c) Possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows.

(d) Stream bank erosion reduction projects.

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Implementation Program Applicable to All Basins

340-41-120 (1) No waste treatment and disposal facilities shall be constructed or operated and no wastes shall be discharged to public waters without obtaining a permit from the Department as required by ORS 468.740.

(2) Plans for all sewage and industrial waste treatment, control, and disposal facilities shall be submitted to the Department for review and approval prior to construction as required by ORS 468.742.

(3) Minimum design criteria for waste treatment and control facilities prescribed under this plan and such other waste treatment and controls as may be necessary to insure compliance with the water quality standards contained in this plan shall be provided in accordance with specific permit conditions for those sources or activities for which permits are required and the following implementation program:

(a) For new or expanded waste loads or activities, fully approved treatment or control facilities, or both shall be provided prior to discharge of any wastes from the new or expanded facility or conduct of the new or expanded activity.

(b) For existing waste loads or activities, additional treatment or control facilities necessary to correct specific unacceptable water quality conditions shall be provided in accordance with a specific program and
timetable incorporated into the waste discharge perm
for the individual discharger or activity. In developin
treatment requirements and implementatio
schedules for existing installations or activities, co
sideration shall be given to the impact upon the overa
environmental quality including air, water, land us
and aesthetics.

(c) Wherever minimum design criteria for wast
treatment and control facilities set forth in this pla
are more stringent than applicable federal standard
and treatment levels currently being provided, upgrad
ing to the more stringent requirements will be defe
red until it is necessary to expand or otherwise modif
or replace the existing treatment facilities. Such defe
ral will be acknowledged in the permit for the source.

(d) Where planning or design or construction
new or modified waste treatment and controls to mee
prior applicable state or federal requirements is unde
way at the time this plan is adopted, such plan
design, or construction may be completed under th
requirements in effect when the project was initiate
Timing for upgrading to meet more stringent futur
requirements will be as provided in paragraph (
above.

(4) Confined animal feeding operations shall b
regulated pursuant to rules contained in OAR Chapte
340, sections 340-51-005 through 340-51-080 in ord
to minimize potential adverse effect on water quality

(5) Programs for control of pollution from no
point sources when developed by the Department, or b
other agencies pursuant to Section 208 of Public La
92-500 and approved by the Department, shall a
applicable, be incorporated into this plan by amen
ment via the same process used to adopt the pla
unless other procedures are established by law.

(6) Where minimum requirements of federal law
enforceable regulations are more stringent tha
specific provisions of this plan, the federal requir
ments shall prevail.

(7) Within a framework of statewide priority a
available resources, the Department will monit
water quality within the basin for the purposes
evaluating conformance with the plan and developin
information for future additions or updating.

(8) The EQC recognizes that the potential exists f
conflicts between Water Quality Management plan
and the Land Use Plans and Resource Manageme
plans which local governments and other agenci
must develop pursuant to law. In the event any suc
conflicts develop, it is the intent of the Department
meet with the local government or responsible agen
to formulate proposed revisions to one or both so as
resolve the conflict. Revisions will be presented f
adoption via the same process used to adopt the pla
unless other specific procedures are established by law

Statutory Authority: ORS 468.020 and 468.735
Hist: Filed and Eff. 1-21-77 as DEQ 128

j) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation or industry shall not be allowed.

(k) Objectionable discoloration, scum, oily sleek, or floating solids, or coating of aquatic life with oil films shall not be allowed.

(l) Aesthetic conditions offensive to the human senses of sight, taste, smell, or touch shall not be allowed.

(m) Radioisotope concentrations shall not exceed Maximum Permissible Concentrations (MPC's) in drinking water, edible fishes or shellfishes, wildlife, irrigated crops, livestock and dairy products, or pose an external radiation hazard.

(n) The concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection shall not exceed one hundred and five percent (105%) of saturation, except when stream flow exceeds the 10-year, 7-day average flood.

(o) Dissolved Chemical Substances: Guide concentrations listed below shall not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in section 340-41-202:

	mg/l
Arsenic (As)	0.01
Barium (Ba)	1.0
Boron (Bo)	0.5
Cadmium (Cd)	0.003
Chromium (Cr)	0.02
Copper (Cu)	0.005
Cyanide (Cn)	0.005
Fluoride (F)	1.0
Iron (Fe)	0.1
Lead (Pb)	0.05
Manganese (Mn)	0.05
Phenols (totals)	0.001
Total dissolved solids—Columbia River	500.0
Total dissolved solids—all other fresh water streams and tributaries thereto	100.0
Zinc (Zn)	0.01

(3) Where the natural quality parameters of waters of the North Coast-Lower Columbia River Basin are outside the numerical limits of the above assigned water quality standards, the natural water quality shall be the standard.

(4) Mixing Zones:

(a) The Department may suspend the applicability of all or part of the water quality standards set forth in this section, except those standards relating to aesthetic conditions, within a defined immediate mixing zone of specified and appropriately limited size adjacent to or surrounding the point of waste water discharge.

(b) The sole method of establishing such mixing zone shall be by the Department defining same in a waste discharge permit.

(c) In establishing a mixing zone in a waste discharge permit the Department:

(A) May define the limits of the mixing zone in terms of distance from the point of the waste water discharge or the area or volume of the receiving water or any combination thereof;

(B) May set other less restrictive water quality standards to be applicable in the mixing zone in lieu of the suspended standards; and

(C) Shall limit the mixing zone to that which in all probability, will:

(i) Not interfere with any biological community or population of any important species to a degree which is damaging to the ecosystem; and

(ii) Not adversely affect any other beneficial use disproportionately.

(5) Testing Methods: The analytical testing methods for determining compliance with the water quality standards contained in this section shall be in accordance with the most recent edition of Standard Methods for the Examination of Water and Waste Water published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation, unless the Department has published an applicable superseding method, in which case testing shall be in accordance with the superseding method; provided, however, that testing in accordance with an alternative method shall comply with this section if the Department has published the method or has approved the method in writing.

[Publications: The publication referred to or incorporated by reference in this rule is available in the office of the Department of Environmental Quality or Secretary of State.]

Statutory Authority: ORS 468.020 and 468.735

Hist: Filed and Eff. 1-21-77 as DEQ 128

Minimum Design Criteria for Treatment and Control of Wastes

340-41-215 Subject to the implementation program set forth in section 340-41-120, prior to discharge of any wastes from any new or modified facility to any waters of the North Coast-Lower Columbia River Basin, such wastes shall be treated and controlled in facilities designed in accordance with the following minimum criteria (In designing treatment facilities, average conditions and a normal range of variability are generally used in establishing design criteria. A facility once completed and placed in operation should operate at or near the design limit most of the time but may operate below the design criteria limit at times due to variables which are unpredictable or uncontrollable. This is particularly true for biological treatment facilities. The actual operating limits are intended to be established by permit pursuant to ORS 468.740 and recognize that the actual performance level may at times be less than the design criteria.):

(1) Sewage Wastes:

(a) During periods of low stream flows (approximately May 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 20 mg/l of BOD and 20 mg/l of SS or equivalent control.

(b) During the period of high stream flows (approximately November 1 to April 30) and for direct ocean discharges: A minimum of Secondary Treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

(c) Effluent BOD concentrations in mg/l, divided by the dilution factor (ratio of receiving stream flow to effluent flow) shall not exceed one (1) unless otherwise approved by the EQC.

(d) Sewage wastes shall be disinfected, after treatment, equivalent to thorough mixing with sufficient chlorine to provide a residual of at least 1 part per million after 60 minutes of contact time unless otherwise specifically authorized by permit.

(e) Positive protection shall be provided to prevent bypassing raw or inadequately treated sewage to public waters unless otherwise approved by the Department where elimination of inflow and infiltration would be necessary but not presently practicable.

(f) More stringent waste treatment and control requirements may be imposed where special conditions may require.

(2) Industrial Wastes:

(a) After maximum practicable inplant control, a minimum of Secondary Treatment or equivalent control (reduction of suspended solids and organic material where present in significant quantities, effective disinfection where bacterial organisms of public health significance are present, and control of toxic or other deleterious substances).

(b) Specific industrial waste treatment requirements shall be determined on an individual basis in accordance with the provisions of this plan, applicable federal requirements, and the following:

(A) The uses which are or may likely be made of the receiving stream;

(B) The size and nature of flow of the receiving stream;

(C) The quantity and quality of wastes to be treated; and

(D) The presence or absence of other sources of pollution on the same watershed.

(c) Where industrial, commercial, or agricultural effluents contain significant quantities of potentially toxic elements, treatment requirements shall be determined utilizing appropriate bioassays.

(d) Industrial cooling waters containing significant heat loads shall be subjected to offstream cooling or heat recovery prior to discharge to public waters.

(e) Positive protection shall be provided to prevent bypassing of raw or inadequately treated industrial wastes to any public waters.

(f) Facilities shall be provided to prevent and contain spills of potentially toxic or hazardous materials and a positive program for containment and cleanup of such spills should they occur shall be developed and maintained.

Statutory Authority: ORS 468.020 and 468.735
Hist: Filed and Eff 1-21-77 as DEQ 128

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Rogue Basin

Beneficial Water Uses to be Protected

340-41-362 Water quality in the Rogue River Basin (see Figures 1 and 6) shall be managed to protect the recognized beneficial uses as indicated in Table 5.

Statutory Authority: ORS 468.020 and 468.735
Hist: Filed and Eff. 1-27-77 as DEQ 128

Water Quality Standards Not to be Exceeded (To be adopted pursuant to ORS 468.735 and enforceable pursuant to ORS 468.720, 468.990, and 468.992.)

340-41-365 (1) Notwithstanding the water quality standards contained below, the highest and best practicable treatment and/or control of wastes, activities, and flows shall in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatues, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor, and other deleterious factors at the lowest possible levels.

(2) No wastes shall be discharged and no activities shall be conducted which either alone or in combination with other wastes or activities will cause violation of the following standards in the waters of the Rogue River Basin:

(a) Dissolved Oxygen (DO):

(A) Fresh Waters: DO concentrations shall not be less than 90 percent of saturation at the seasonal low, or less than 95 percent of saturation in spawning areas during spawning, incubation, hatching, and fry stages of salmonid fishes.

(B) Marine and Estuarine Waters (Outside of zones of upwelled marine waters naturally deficient in DO): DO concentrations shall not be less than 6 mg/l for estuarine waters, or less than saturation concentrations for marine waters.

(b) Temperature:

(A) Fresh Waters: No measurable increases shall be allowed when stream temperatures are 58° F. or greater; or more than 0.5°F. increase due to a single-source discharge when receiving water temperatures are 57.5° F. or less or more than 2° F. increase due to all sources combined when stream temperatures are 56° F. or less, except for specifically limited duration activities which may be specifically authorized by DEQ under such conditions as it may prescribe and which are necessary to accommodate legitimate uses or activities where temperatures in excess of this standard are unavoidable.

(B) Marine and Estuarine Waters: No significant increase above natural background temperatures shall be allowed, and water temperatures shall not be altered to a degree which creates or can reasonably be expected to create an adverse effect on fish or other aquatic life.

(c) Turbidity (Jackson Turbidity Units, JTU): No more than a 10 percent cumulative increase in natural stream turbidities shall be allowed except for certain specifically limited duration activities which ma specifically authorized by DEQ under such condition as it may prescribe and which are necessary to accommodate essential dredging, construction, or othe legitimate uses or activities where turbidities in exce of this standard are unavoidable.

(d) pH (Hydrogen Ion Concentration): pH valu shall not fall outside the following ranges:

(A) Marine Waters: 7.0 – 8.5

(B) Estuarine and Fresh Waters: 6.5 – 8.5

(e) Organisms of the Coliform Group where A sociated with Fecal Sources (MPN or equivalent M using a representative number of samples):

(A) Estuarine Waters: Average concentrations o coliform bacteria shall not exceed 240 per 100 ml o exceed this value in more than 20% of samples.

(B) Marine Waters: The median concentration o coliform bacteria shall not exceed 70 per 100 ml

(C) Mainstem Rogue River from the point of sal water intrusion, approximately River Mile 4, upstream to Dodge Park, River Mile 138.4, and Bear Creek Average concentrations of coliform organisms shal not exceed 1000 per 100 milliliters, except durin periods of high natural surface runoff.

(D) Rogue River above Dodge Park and all unspecified tributaries: Average concentrations of coliform organisms shall not exceed 240 per 100 mill ters, except during periods of high natural sur runoff.

(f) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation or otherwise injurious to public health shall not b allowed.

(g) The liberation of dissolved gases, such as carbon-dioxide, hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to b deleterious to fish or other aquatic life, navigation recreation, or other reasonable uses made of such waters shall not be allowed.

(h) The development of fungi or other growths having a deleterious effect on stream bottoms, fish o other aquatic life, or which are injurious to health, recreation, or industry shall not be allowed.

(i) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish shall not be allowed.

(j) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed.

(k) Objectionable discoloration, scum, oily sleek or floating solids, or coating of aquatic life with oil fil shall not be allowed.

(l) Aesthetic conditions offensive to the human senses of sight, taste, smell, or touch shall not be allowed.

(m) Radioisotope concentrations shall not exceed Maximum Permissible Concentrations (MPC's) in drinking water, edible fishes or shellfishes, wildlife, irrigated crops, livestock and dairy products, or pose an external radiation hazard.

(n) The concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection shall not exceed one hundred and five percent (105%) of saturation, except when stream flow exceeds the 10-year, 7-day average flood.

(o) Dissolved Chemical Substances: Guide concentrations listed below shall not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in section 340-41-362:

	mg/l
Arsenic (As)	0.01
Barium (Ba)	1.0
Boron (Bo)	0.5
Cadmium (Cd)	0.003
Chromium (Cr)	0.02
Copper (Cu)	0.005
Cyanide (Cn)	0.005
Fluoride (F)	1.0
Iron (Fe)	0.1
Lead (Pb)	0.05
Manganese (Mn)	0.05
Phenols (totals)	0.001
Total dissolved solids	500.0
Zinc (Zn)	0.01

(3) Where the natural quality parameters of waters of the Rogue Basin are outside the numerical limits of the above assigned water quality standards, the natural water quality shall be the standard.

(4) Mixing Zones:

(a) The Department may suspend the applicability of all or part of the water quality standards set forth in this section, except those standards relating to aesthetic conditions, within a defined immediate mixing zone of specified and appropriately limited size adjacent to or surrounding the point of waste water discharge.

(b) The sole method of establishing such mixing zone shall be by the Department defining same in a waste discharge permit.

(c) In establishing a mixing zone in a waste discharge permit the Department:

(A) May define the limits of the mixing zone in terms of distance from the point of the waste water discharge or the area or volume of the receiving water or any combination thereof;

(B) May set other less restrictive water quality standards to be applicable in the mixing zone in lieu of the suspended standards; and

(C) Shall limit the mixing zone to that which in all probability, will:

(i) Not interfere with any biological community or population of any important species to a degree which is damaging to the ecosystem; and

(ii) Not adversely affect any other beneficial use disproportionately.

(5) Testing Methods: The analytical testing methods for determining compliance with the water quality standards contained in this section shall be in accordance with the most recent edition of Standard Methods for the Examination of Water and Waste Water published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation, unless the Department has published an applicable superseding method, in which case testing shall be in accordance with the superseding method; provided, however, that testing in accordance with an alternative method shall comply with this section if the Department has published the method or has approved the method in writing.

[**Publications:** The publication referred to or incorporated by reference in this rule is available in the office of the Department of Environmental Quality or Secretary of State.]

Statutory Authority: ORS 468.020 and 468.735

Hist: Filed and Eff. 1-21-77 as DEQ 128

Minimum Design Criteria for Treatment and Control of Wastes

340-41-375 Subject to the implementation program set forth in section 340-41-120, prior to discharge of any waste from any new or modified facility to any waters of the Rogue River Basin, such wastes shall be treated and controlled in facilities designed in accordance with the following minimum criteria (In designing treatment facilities, average conditions and a normal range of variability are generally used in establishing design criteria. A facility once completed and placed in operation should operate at or near the design limit most of the time but may operate below the design criteria limit at times due to variables which are unpredictable or uncontrollable. This is particularly true for biological treatment facilities. The actual operating limits are intended to be established by permit pursuant to ORS 468.740 and recognize that the actual performance level may at times be less than the design criteria.):

(1) Sewage Wastes:

(a) During periods of low stream flows (approximately May 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 10 mg/l of BOD and 10 mg/l of SS or equivalent control.

(b) During the period of high stream flows (approximately November 1 to April 30): A minimum of Secondary Treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

(c) Effluent BOD concentrations in mg/l, divided by the dilution factor (ratio of receiving stream flow to effluent flow) shall not exceed one (1) unless otherwise approved by the EQC.

(d) Sewage wastes shall be disinfected, after treatment, equivalent to thorough mixing with sufficient chlorine to provide a residual of at least 1 part per million after 60 minutes of contact time unless otherwise specifically authorized by permit.

(e) Positive protection shall be provided to prevent bypassing raw or inadequately treated sewage to public waters unless otherwise approved by the Department where elimination of inflow and infiltration would be necessary but not presently practicable.

(f) More stringent waste treatment and control requirements may be imposed where special conditions may require.

(2) Industrial Wastes:

(a) After maximum practicable inplant control, a minimum of Secondary Treatment or equivalent control (reduction of suspended solids and organic material where present in significant quantities, effective disinfection where bacterial organisms of public health significance are present, and control of toxic or other deleterious substances).

(b) Specific industrial waste treatment requirements shall be determined on an individual basis in accordance with the provisions of this plan, applicable federal requirements, and the following:

(A) The uses which are or may likely be made of the receiving stream;

(B) The size and nature of flow of the receiving stream;

(C) The quantity and quality of wastes to be treated; and

(D) The presence or absence of other sources of pollution on the same watershed.

(c) Where industrial, commercial, or agricultural effluents contain significant quantities of potentially toxic elements, treatment requirements shall be determined utilizing appropriate bioassays.

(d) Industrial cooling waters containing significant heat loads shall be subjected to offstream cooling or heat recovery prior to discharge to public waters.

(e) Positive protection shall be provided to prevent bypassing of raw or inadequately treated industrial wastes to any public waters.

(f) Facilities shall be provided to prevent and contain spills of potentially toxic or hazardous materials and a positive program for containment and cleanup of such spills should they occur shall be developed and maintained.

Statutory Authority: ORS 468.020 and 468.735
Hist: Filed and Eff. 1-21-77 as DEQ 128

Figure 6
ROGUE BASIN
(340-41-362)

(Note: Basin boundaries are as shown in figure below)

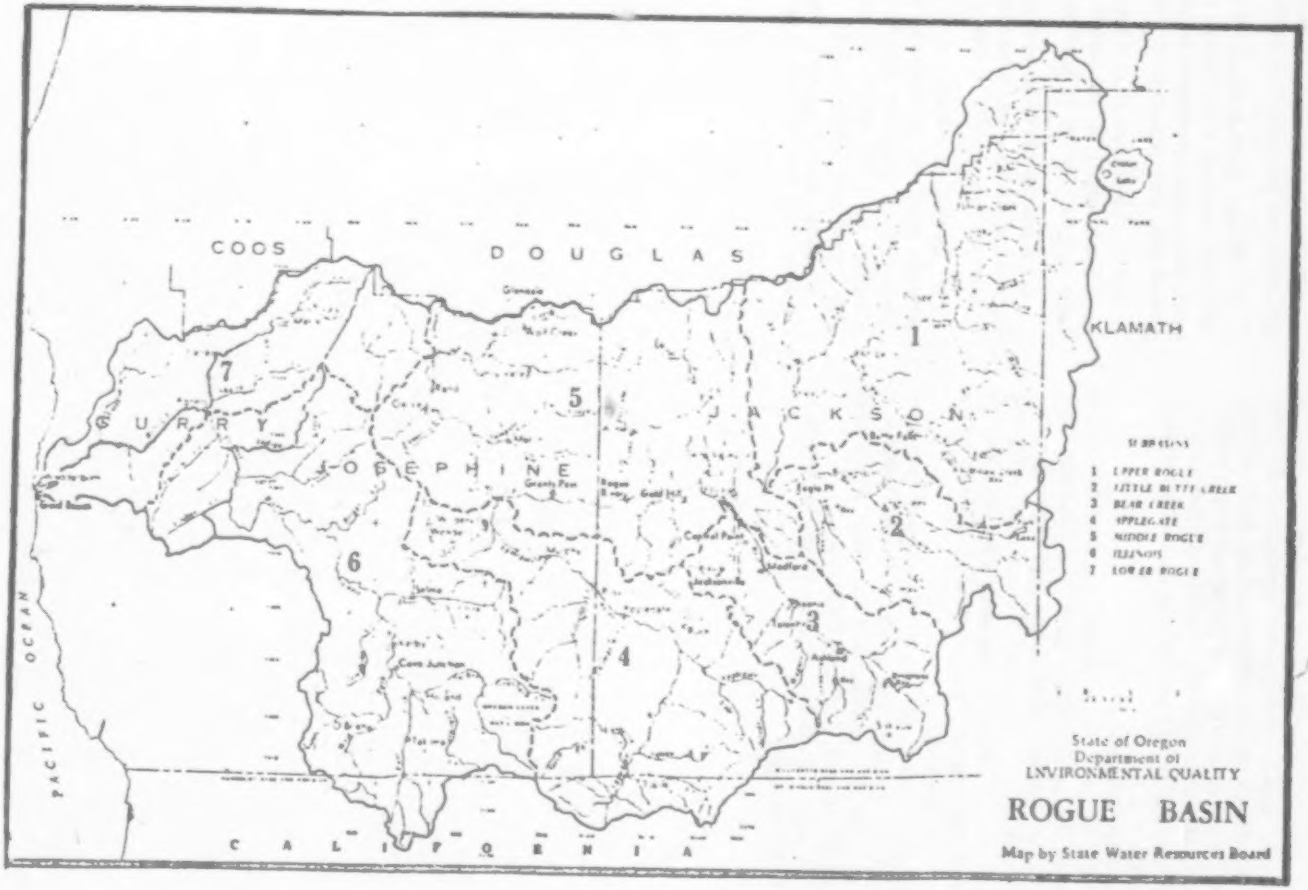
COOS
DOUGLAS
KLAMATH
CURRY
JOSEPHINE
JACKSON
CALIFORNIA
PACIFIC OCEAN
1
2
3
4
5
6
7
SUBBASINS
1 UPPER ROGUE
2 LITTLE BUTTE CREEK
3 BEAR CREEK
4 APPLEGATE
5 MIDDLE ROGUE
6 ILLINOIS
7 LOWER ROGUE
State of Oregon
Department of
ENVIRONMENTAL QUALITY
ROGUE BASIN
Map by State Water Resources Board

TABLE 5
(340-41-362)

Beneficial Uses	Rogue River Estuary & Adjacent Marine Waters	Rogue River Main Stem from Estuary to Lost Creek Dam	Rogue River Main Stem above Lost Creek Dam	Bear Creek Main Stem	All other Tributaries to Rogue River & Bear Creek
Public Domestic Water Supply		X	X	X*	X
Private Domestic Water Supply		X	X		X
Industrial Water Supply	X	X	X	X	X
Irrigation		X	X	X	X
Livestock Watering		X	X	X	X
Anadromous Fish Passage	X	X	X	X	X
Salmonid Fish Rearing	X	X	X	X	X
Salmonid Fish Spawning		X	X	X	X
Resident Fish & Aquatic Life	X	X	X	X	X
Wildlife & Hunting	X	X	X	X	X
Fishing	X	X	X	X	X
Boating	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X
Aesthetic Quality	X	X	X	X	X
Hydro Power			X		X
Commercial Navigation & Transportation	X	X			

*Formally designated as under study; City of Talent using Bear Creek for water supply since.

APPENDIX B

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DEPARTMENT OF ENVIRONMENTAL QUALITY
P.O. Box 1760 (522 S.W. Fifth Avenue)
Portland, Oregon 97207
Telephone: (503) 229-5696

Permit Number: 2761
Expiration Date: 1/31/83
File Number: 3780
Page 1 of 6

WATER POLLUTION CONTROL FACILITIES PERMIT

Issued pursuant to ORS 468.740

ISSUED TO:

City of Ashland
20 E. Main Street
Ashland, Oregon 97520

PLANT TYPE AND LOCATION:

Reeder Reservoir is located on Ashland Creek three miles south of City Center

Issued in response to application number 2197 received 12/7/77.

William H. Young
William H. Young
Director

SEP 26 1978
Date

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Method of Disposal
Reservior sediments	Removal and discharge during wet season

RIVER BASIN INFORMATION

Major Basin: Rogue
Minor Basin: Bear Creek
County: Jackson

Nearest surface stream which could be influenced by waste disposal system: Ashland Creek

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to construct, install, modify or operate waste water treatment, control and disposal facilities in conformance with requirements, limitations and conditions set forth in attached schedules as follows:

	Page
Schedule A - Waste Disposal Limitations	2
Schedule B - Minimum Monitoring and Reporting Requirements	3
Schedule C - Compliance Conditions and Schedules	4
Schedule D - Special Conditions	-
General Conditions	5-6

This permit does not relieve the permittee from responsibility for compliance with other applicable Federal, state or local laws, rules or standards.

SCHEDULE A

Waste Disposal Limitations

1. Waste Discharge Limitations Not to Be Exceeded After Permit Issuance Date

April 1 - November 14:	No discharge of accumulated reservoir sediments to public waters is permitted.
November 15 - March 31:	Discharge of accumulated reservior sediments to public waters is permitted during periods of high stream flow.

2. The City of Ashland shall notify the Department prior to the implementation of any proposed sediment removal activities. Notification shall include:

   a. Written notification of tentative time schedule thirty days prior to implementation; and

   b. Verbal notification of final time schedule 16 hours prior to implementation.

State of Oregon
Department of Environmental Quality

PERMIT CONDITIONS

Permit Number: 2761
Expiration Date: 1/31/83
Page 3 of 6

City of Ashland

SCHEDULE B

Minimum Monitoring and Reporting Requirements

The permittee shall monitor the operation and efficiency of all treatment and disposal facilities. Unless otherwise agreed to in writing by the Department of Environmental Quality, data collected and submitted shall include but not necessarily be limited to the following parameters and minimum frequencies:

Item or Parameter	Minimum Frequency	Type of Sample
Quantity of sediment discharged	Daily when removing sediment	Estimate
Settleable Solids, Suspended Solids and Turbidity	Daily sample of Ashland Creek at filtration plant, weekly sample of Ashland Creek near mouth (STP) and Bear Creek at Oak Street and Valley View Road	Grab
Quantity of accumulated sediment	Annually	Estimate based on grid soundings

Reporting Procedures

Monitoring results shall be reported on approved forms. The reporting period is the calendar month. Reports must be submitted to the Department by the 15th day of the following month. Reports are only required during those months that sediment is being removed.

SCHEDULE C

Compliance Conditions and Schedules

1. The permittee shall cooperate with the U.S. Forest Service (USFS) to develop an Ashland Creek watershed management and monitoring plan as outlined in the City/USFS Memorandum of Understanding revised on October 7, 1977. The City of Ashland shall submit annual progress reports on the development of the interim and long range plans to the Department by January 15 of each year.

2. As soon as practicable, but not later than December 31, 1978, the permittee shall prioritize and establish inplementation time schedules for the recommendations involving the operation of Reeder Reservoir including in the "City of Ashland, Oregon, Water Resources Management Plan and Facility Study", October 20, 1977. These recommendations included:

   a. Purchase of cutterhead dredge and discharge pipeline;

   b. Modification of bottom outlet trash rack;

   c. Installation of multiple level water intake assembly; and

   d. Preparation of engineering study on structural feasibility of enlarging the present 24-inch opening through the base of the dam to 48-inches.

SCHEDULE D

Special Conditions

Condition G2 of the attached General Conditions does not apply to this permit.

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GENERAL CONDITIONS

G1. The permittee shall provide an adequate operating staff which is duly qualified to carry out the operation, maintenance and testing functions required to insure compliance with the conditions of this permit.

G2. All waste collection, control, treatment and disposal facilities shall be operated in a manner consistent with the following:

a. At all times all facilities shall be operated as efficiently as possible and in a manner which will prevent discharges, health hazards and nuisance conditions.

b. All screenings, grit and sludge shall be disposed of in a manner approved by the Department of Environmental Quality such that it does not reach any of the waters of the state or create a health hazard or nuisance condition.

c. Bypassing of untreated waste is generally prohibited. No bypassing shall occur without prior written permission from the Department except where unavoidable to prevent loss of life or severe property damage.

G3. Whenever a facility expansion, production increase or process modification is anticipated which will result in a change in the character of pollutants to be discharged or which will result in a discharge to public waters, a new application must be submitted together with the necessary reports, plans and specifications for the proposed changes. No change shall be made until plans have been approved and a new permit or permit modification has been issued.

G4. After notice and opportunity for a hearing this permit may be modified, suspended or revoked in whole or in part during its term for cause including but not limited to the following:

a. Violation of any terms or conditions of this permit or any applicable rule, standard, or order of the Commission;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts.

G5. The permittee shall, at all reasonable times, allow authorized representatives of the Department of Environmental Quality:

a. To enter upon the permittee's premises where a waste source or disposal system is located or in which any records are required to be kept under the terms and conditions of this permit;

b. To have access to and copy any records required to be kept under the terms and conditions of this permit;

c. To inspect any monitoring equipment or monitoring method required by this permit; or

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d. To sample any discharge of pollutants.

G6. The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

G7. The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

G8. The Department of Environmental Quality, its officers, agents and employees shall not sustain any liability on account of the issuance of this permit or on account of the construction or maintenance of facilities because of this permit.

G9. In the event the permittee is unable to comply with all of the conditions of this permit because of a breakdown of equipment or facilities, an accident caused by human error or negligence, or any other cause such as an act of nature, the permittee shall:

a. Immediately take action to stop, contain and clean up the unauthorized discharges and correct the problem.

b. Immediately notify the Department of Environmental Quality so that an investigation can be made to evaluate the impact and the corrective actions taken and determine additional action that must be taken.

c. Submit a detailed written report describing the breakdown, the actual quantity and quality of resulting waste discharges, corrective action taken, steps taken to prevent a recurrence and any other pertinent information.

Compliance with these requirements does not relieve the permittee from responsibility to maintain continuous compliance with the conditions of this permit or the resulting liability for failure to comply.

G10. Definitions of terms and abbreviations used in this permit:

a. BOD means five-day biochemical oxygen demand.
b. TSS means total suspended solids.
c. mg/l means milligrams per liter.
d. kg means kilograms.
e. m^3/d means cubic meters per day.
f. MGD means million gallons per day.
g. Averages for BOD and TSS are based on arithmetic mean of samples taken.
h. Average coliform or fecal coliform is based on geometric mean of samples taken.
i. Composite sample means a combination of samples collected, generally at equal intervals over a 24-hour period, and apportioned according to the volume of flow at the time of sampling.
j. FC means fecal coliform bacteria.

APPENDIX C

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EXHIBIT I

UNITED STATES DEPARTMENT OF AGRICULTURE

Office of the Secretary

COOPERATIVE AGREEMENT FOR THE PURPOSE OF CONSERVING AND PROTECTING THE WATER SUPPLY OF THE CITY OF ASHLAND, OREGON

This AGREEMENT made and entered into this 21st day of August, one thousand, nine hundred and twenty nine by and between the City of Ashland, State of Oregon, through J. Edw. Thornton, its Mayor, and the United States Department of Agriculture, through R. W. Dunlap, Acting, Secretary of Agriculture, WITNESSETH that,

WHEREAS, the following described lands: all national forest lands in townships 39 and 40 shouth, ranges 1 west and 1 east, W.M. within the watershed of Ashland Creek, comprising approximately 11,432 acres, within the boundaries of Crater National Forest, are within the watershed from which the water supply of the City of Ashland is obtained:

NOW, THEREFORE, for the purpose of conserving and protecting the water supply of said city, it is agreed:

1. That before entering into any greement for the cutting of timber or removal of other forest products from national forest lands within the area, the officials of the City of Ashland will be consulted and full consideration will be given to any requirements the City of

EXHIBIT I (CONT.)

Ashland may desire to impose as necessary for the safeguarding of the water supply.

2. That in permitting the use of said lands for timber cutting or other purposes, full consideration sall be given to the preservation of the volume and purity of the city water supply, and if the proper State or federal agencies shall determine, after due study and investigation, that the City water supply is being or will be demiaished, ~~gm~~ contaminated, or polluted through permitted operations upon said lands, and there is no other more practicable remedy for the situation, the Secretary, so far as he has legal authority to do so, will cause such permitted operations to be restricted, modified, or discontinued.

3. Grazing of livestock on national forest lands in the watershed will not be authorized by the Forest Service except with the consent of the officials of the City of Ashland. Any fencing or other improvements found necessary to effectively exclude livestock from the watershed or to aid in safeguarding the water supply will be constructed and maintained by the City under special use permit to be issued by the Forest Supervisor.

4. So far as practicable with the means at his disposal, the Secretary of Agriculture will extend and improve the forests upon these lands by seeding and planting, and by the most approved methods of silviculture and forest management.

5. The Forest Service will administer and protect the area in connection with adjoining national forest lands. Should the City of

EXHIBIT I (CONT.)

Ashland desire any special protective measures not provided by the regular Forest Service administration, they may be obtained at the expense of the City of Ashland by the appointment of additional employees to be appointed by and to be directly responsible to the Forest Supervisor of the Crater National Forest, but their compensation will be paid by the said City the same rate as men employed by the Forest Service on similar duties.

6. Both parties reserve the right to terminate this agreement at any time on notice to the other party, provided that all obligations under the agreement up to the date of the termination have been met.

The undersigned agree to the above propositions and agree to carry them out so far as they have official power and authority to do so.

CITY OF ASHLAND

By /s/ J. Edw. Thornton
Mayor

Attest:

Gertrude Biwe, Recorder

Signed R. W. Dunlap
Acting Secretary of Agriculture

APPENDIX D

ENVIRONMENTAL CRITERIA GUIDELINES FRESHWATER: ACTIVITY/LIFE STAGE/FACTORS

Bear Creek: Summer Steelhead

Activity/Life Stage

Factors	Adult Passage	Spawning Eggs-Adults	Incubation eggs-sacfry	Emergence Fry	Dispersal fry-finger	Rearing fingers-juv.	Smolting Juveniles	Smolt Passage	Adult out-migration
Dates	Dec-Mar	Dec-Mar	Dec-May	Mar-May	Mar-Jun	All year	Mar-May	Mar-May	Jan-Apr
Depths (min.)	0.6 ft. (25% of wetted surface	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.6 ft.
Velocity	<8 fps	1-3 fps	>1.5 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps
Temperature	45-60°F	43-55°F	43-55°F	43-55°F	43-55°F	43-65°F	45-55°F	45-60°F	45-60°F
DO	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm
Substrate		gravel (.5-4 in) <20% fines	gravel (.5-4 in.) <20% fines	gravel (.5-4 in.) <20% fines	gravel < 20% fines	gravel <20% fines			
Barriers	<1 ft (multiple) 2-3 ft (single)								

ENVIRONMENTAL CRITERIA GUIDELINES FRESHWATER:
ACTIVITY/LIFE STAGE/FACTORS

Bear Creek: Winter Steelhead

Activity/Life Stage

Factors	Adult Passage	Spawning Eggs-Adults	Incubation eggs-sacfry	Emergence Fry	Dispersal fry-finger	Rearing fingers-juv.	Smolting Juveniles	Smolt Passage	Adult out-migrati
Dates	Feb-May	Mar-May	Mar-Jul	Apr-Jul	May-Aug	All year	Mar-May	Mar-May	Feb-Jun
Depths (min.)	0.6 ft. (25% of wetted surface	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.6 ft.
Velocity	<8 fps	1-3 fps	>1.5 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps
Temperature	45-60°F	43-55°F	43-55°F	43-55°F	43-55°F	43-65°F	45-55°F	45-60°F	45-60°F
DO	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm
Substrate		gravel (.5-4 in) <20% fines	gravel (.5-4 in.) <20% fines	gravel (.5-4 in.) <20% fines	gravel < 20% fines	gravel <20% fines			
Barriers	≤1 ft (multiple) 2-3 ft (single)								

ENVIRONMENTAL CRITERIA GUIDELINES FRESHWATER: ACTIVITY/LIFE STAGE/FACTORS

Bear Creek: Coho Salmon

	Activity/Life Stage							
Factors	Adult Passage	Spawning Eggs-Adults	Incubation Eggs-Sacfry	Emergence Fry	Dispersal Fry-Finger	Rearing Fingers-Juv.	Smolting Juveniles	Smolt Passage
Dates	Nov-Dec	Nov-Jan	Nov-Mar	Feb-Apr	Feb-May	All Year	Mar-May	Mar-May
Depths (min.)	0.6 feet (25% of wetted area)	0.5 feet	0.5 feet	0.5 feet	0.5 feet	0.5 feet	0.5 feet	0.5 feet
Velocity	<8 fps	1-3 fps	>1.5 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps
Temperature	45-60°F	43-55°F	43-55°F	43-55°F	43-55°F	43-65°F	45-55°F	45-60°F
DO	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm
Substrate		gravel (.5-4 in.) <20% fines	gravel (.5-4 in.) <20% fines	gravel (.5-4 in.) <20% fines	gravel <20% fines	gravel <20% fines		
arriers	≤1 ft (multiple) ≥2-3 ft (single)							

ENVIRONMENTAL CRITERIA GUIDELINES FRESHWATER:
ACTIVITY/LIFE STAGE/FACTORS

Bear Creek: Chinook Salmon (Fall Run)

	Activity/Life Stage							
Factors	Adult Passage	Spawning Eggs-Adults	Incubation eggs-sacfry	Emergence Fry	Dispersal fry-finger	Rearing fingers-juv.	Smolting Juveniles	Smolt Passage
Dates	Oct-Dec	Oct-Dec	Oct-Mar	Feb-Mar	Feb-Mar	Mar-Jun	Mar.-May (in Rogue R.)	Mar.-May (in Rogue R.)
Depths (min.)	0.8 ft (25% of wetted surface	0.8 ft	0.5 ft	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.	0.5 ft.
Velocity	<8 fps	1-3 fps	>1.5 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps	1-3 fps
Temperature	51-67°F	43-58°F	43-58°F	43-58°F	43-58°F	43-65°F	45-58°F	45-60°F
DO	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm	>7 ppm
Substrate		gravel (1-6 in.) <20% fines	gravel (1-6 in.) <20% fines	gravel (1-6 in.) <20% fines	gravel <20% fines	gravel <20% fines		
Barriers	≤1 ft (multiple) 2-3 ft (single)							